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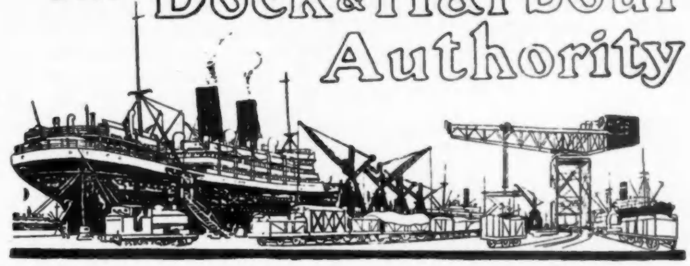


No. 341. Vol. XXIX. MARCH, 1949.

CONTENTS

Editorial Comments

Reconstruction of the Watier Lock, Dunkirk.

In the following pages we are pleased to be able to print an abridged translation of two articles upon the reconstruction of the Watier Lock in the Port of Dunkirk.

After an introduction by Mons. Le Gorgen, Engineer-in-Chief of the Department of Bridges and Roads under whose direction the works were executed, M. L.-P. Brice describes the work in detail. Space considerations prevent us printing the details of the repair of the lock gates and their mechanism described in a third article by Mons. M. J. Grenet, but it must be said that this work was of the greatest consequence in the scheme and we refer to it in a later paragraph.

The value of Dunkirk to France as a port is well known and the Watier Lock is of equal concern to the port itself, for of the three locks in the port, the only other deep water lock—the Trystram, is small in comparison.

The Germans were equally aware of the importance to the Allies of Dunkirk for it could give them direct access to Germany, the Nazis consequently set out to heavily damage the port installations and the Watier Lock in particular.

The articles reveal that a complete change of design was involved during the progress of the repairs originally planned owing to the difficulties experienced in clearing the lock of wrecks and debris without first dewatering it and excluding the tides, a course eventually carried out.

The design of the combined mass concrete foundation walls and pre-cast concrete trestle works shows methods of considerable ingenuity in retaining the sand upon which the lock is built and reducing the vertical load on the existing steel sheet piling, the undamaged portion of which was incorporated in the design. A continuous lock coping and sloping rear retaining wall was formed by casting concrete in situ in the spaces between the pre-cast trestles; the horizontal beams to carry the lower ends of the vertical timber fenders were pre-cast.

It was fortunate that of the three sliding lock gates one only was severely damaged and it was in part due to the rapidity with which these gates were reconstructed, repaired and fitted into position in the Watier Lock together with the closing of the other locks that enabled the Lock to be dewatered for the under-water work of clearance of wrecks and debris and the permanent scheme of reconstruction to be carried out.

The photograph made in December, 1946, shows the condition of the Watier Lock on that date and a glance at the picture taken nine months later in September, 1947, indicates a remarkable achievement in reconstruction work in a short space of time.

The whole of the works reflect great credit upon all concerned; they were begun in January, 1947, and water was admitted to the lock on September 21st of that same year.

Hydrography from the Air.

It is becoming generally accepted that aerial photography forms a valuable adjunct to the ordinary methods of ground surveying by instruments. Vast areas of the earth's surface have now been mapped by photography from the air, for purposes such as air survey and mapping, town planning, irrigation, road and railway location, forestry and other planting schemes, oil prospecting and archeology. Very little, however, has been heard of its potentialities in respect to hydrographic survey work, and we are therefore interested in two aerial photographs of Boulogne Harbour sent to us by Captain E. C. Shankland, R.N.R., which we reproduce on a following page.

Those readers who were on active service during World Wars I and II will remember the excellent aerial photographs of the enemy's systems of trenches and other defensive works and positions and the maps which were produced from them. The work of Coastal Command of the Royal Air Force and the Fleet Air Arm of the Royal Navy submarine spotting during the last war will also be recalled.

Judging from the photographs of Boulogne Harbour, it seems probable that aerial photography may prove a valuable adjunct in hydrographic surveys in estuaries, harbours, the shallow waters around coasts, and hitherto unchartered areas of the sea. Thus another step may have been taken to counter the unseen of the hydrographic art.

Ocean Waves and Swell.

An article on page 280, describes briefly the general lines of the work and studies carried out at the Admiralty Research Station, Teddington, together with some data already obtained and certain conclusions arrived at.

The subject is one of considerable importance and interest, and, as a result of the information now being gathered, it appears possible that tidal phenomena observed on some coasts and in some harbours, instead of being caused by more or less local storms, or other local conditions or configuration of the sea bed, may very well be the result of storms occurring as far away as 3,000 to 6,000 miles.

Editorial Comments—continued

We have in mind particularly the "Run or Range" condition, as it is known, in Table Bay Harbour, South Africa, the usual manifestation of which appears to be a visible current of water through the entrances of all the basins, which reverses direction at approximately regular intervals—generally every two or three minutes, but sometimes at intervals of longer duration.

On such occasions ships at their berths move to-and-fro or off-and-on and the unequal tension on the mooring ropes often results in breakage, and there have been instances when it has been found necessary to hold vessels by means of tugs.

Range seems to usually occur during fierce winter storms from the North-West, and the action generally reaches its peak after the local subsidence of the storm, but it is also sometimes experienced in calm weather, even without the accompaniment of a storm. Also it does not follow that every storm which passes over Cape Town will necessarily cause range disturbance.

It seems apparent, therefore, that reliable forecasts of the approach of destructive swell conditions would be of the greatest assistance at Table Bay and in other harbours and anchorages subject to similar phenomena.

The seismic technique as a means for ascertaining such information still remains to be perfected, but a considerable advance along these lines of approach has been made. Moreover, the observations and investigations being carried out in respect to refraction of waves by submerged promontories and shoals or tidal streams and surf will be of the greatest value in the solution of problems of coastal erosion and the protection of harbours.

Further developments in the study of ocean waves and swell will be awaited with interest by all concerned, and we hope in due course to be able to add to the valuable research already carried out, by further articles on the subject from various sources.

African Transport Problems.

Elsewhere in this issue, we publish a letter from Brigadier G. S. Brumskill, who has had considerable experience of African waterways, roads, railways and ports, and while we do not associate ourselves with some of his remarks, his proposal that the transport problems of Africa should be considered on a Pan-African basis appears to be worthy of careful consideration.

Last month we were able to give some information on the subject of East African transport problems, in the course of which it was mentioned that a series of conferences had been held recently to enquire into these questions, with special reference to projected improvements at the Ports of Dar Es Salaam and Mombasa, and to future railway and road construction.

It should not be forgotten that the Ground Nut Scheme in East Africa was carried into effect by reason of the pressing need to lessen fat shortages in the United Kingdom by one-third within the Marshall aid period, which consideration no doubt justified some haste as well as a considerable initial outlay. At the same time, however, it is not to be inferred that transport, and the means of shipping the produce, was entirely neglected as of minor importance.

On the contrary, considerable extensions were planned at the Port of Dar Es Salaam, together with a railway to link the whole Tanganyikan system with the Port of Mombasa, in order that it might participate in the movement of traffic over and above that which Dar Es Salaam could handle. The actual siting, however, of certain of the proposed railways and roads appears to be not yet decided upon.

More recently, proposals of far-reaching importance were made at a Conference, held at Victoria Falls, to form a Federation of Southern and Northern Rhodesia and Nyassaland under one constitution. The creation of a new Federal Dominion, with 4 or 5 million natives, certainly not ripe for the vote or racial equality, and having at present a white population of little over one hundred thousand, is a matter of vital concern to Commonwealth welfare and interests, and the establishment of a full democratic system is one which must take time to develop.

The suggestion is that the Central African Dominion will ultimately link up with an East African Dominion consisting of Kenya, Uganda and Tanganyika, and in view of these large issues now being debated, it seems evident that the Ground Nuts Scheme in East Africa must be considered as a preliminary scheme, which, with its improved transport and port facilities, will be eventually linked up with the development of the proposed Federation of States and the future Central African Dominion.

This Dominion, with its hydro-electric power stations situated on the various falls, its irrigation and other canals uniting the high inland waters with the great rivers, its concrete roads, railways and new sea ports, is an entrancing vision. At present, however, it is little more, and plans have still to be approved and carried into effect. The fulfilment of the plans will undoubtedly be of the greatest importance to Britain and the Commonwealth as a whole, as a vast source of food and raw materials of many and varied kinds will then become available.

This long term planning, although of value, must not, however, be allowed to obscure the needs of the present, and care must be taken that the preliminary schemes of production, undertaken under the short term policies, shall be so planned as to form eventually an integral part of the complete scheme for development of East, West and Central Africa.

Northern Ireland Lighthouses.

The control of lighthouses in Northern Ireland is a subject which has been in dispute between the United Kingdom and Eire since 1921, but as a result of Eire becoming a Republic, its settlement between the two countries is now essential.

According to the Act of 1920, the Irish Free State was to be responsible for the maintenance of lighthouses, buoys and navigation aids. It was also enacted that these should not be removed or added to except by agreement with the British Government.

Successive governments of Eire, however, have refused to interpret the Act as meaning that they were meant to pay for the upkeep. The Board of Trade has continued, therefore, to finance, to the extent of £250,000 per annum, the Irish Lights Commissioners through the Lights Fund, to which the Eire Government forwards dues, with the administration of the lights of the whole coast of Ireland remaining under the Commissioners in Dublin.

It is understood that Sir Basil Brooke is pressing for control of the Northern Ireland Lights to be removed from Dublin, probably to the Commissioners of Northern Lighthouses, Edinburgh, who are also responsible for the Isle of Man Lights.

While most of the shipping passing the coast of Eire is bound to or from Great Britain, it may be proposed, consistent with its independence as a Republic, that Eire should bear a greater part of the cost of its own lighthouses in the same way as other countries.

There are, however, some important points which will require solution, for example, the navigation of Lough Foyle. As Londonderry is now a naval base of strategic importance, it is urged that the lights marking the approaches should be under British control. This, however, appears to involve more than the scope of the Irish Lights Commissioners, for it raises the question as to what are Eire territorial waters, the Eire Government having always claimed sovereignty over Lough Foyle.

There also arises the question of control in the case of Belfast, where the lighthouses at Blackhead and New Island would be technically under the control of the Republic of Eire.

Whatever is the outcome of the discussions on territorial waters, it is most probable that the existing arrangements with the Irish Lights Commissioners may now be amended.

Trinity House Lightships.

While on the subject of navigational lighting, it is interesting to observe that, arising from new Board of Trade Regulations, lightships are now, among other requirements, to be fitted with improved accommodation for the crews, including two-berth cabins, fitted bathrooms, comfortable mess deck and modern galleys.

Lightship crews still sleep in hammocks and bathe in wooden tubs, but as ships come off service for periodical refitting and overhaul, modern amenities are to be provided.

The Port of Dunkirk

Reconstruction of the Watier Ship Lock*

Introduction

By M. Le GORGEN.

THE opening of the Watier Lock in the middle of October, 1947, was a very important event in the life of the Port of Dunkirk, for, since August, 1946, the basins of the port could be reached only through the Guillian Lock, which had suffered the least war damage, but was the smallest maritime lock. For this reason, the draught of ships coming alongside the quay was normally restricted to 5 metres.

In order to restore the port to its pre-war prosperity, it was therefore vitally necessary to restore one at least of the two deep water locks: the Trystram or the Watier. The former was too heavily damaged to be repaired in a reasonable time.

On the other hand, although the two side walls of the Watier Lock had suffered severely from German demolitions, the entrances and two of the three lock gates were in good condition. It was therefore decided to concentrate reconstruction work on this lock.

At the time of the Liberation it was hoped to be able to put the lock back into service rapidly, at least temporarily. Two lines of sheet piling were driven to retain the sand. The clearance of debris began in the middle of 1945, but under extremely difficult conditions. The lock was blocked by nearly 7,000 tons of twisted steelwork, partly covered by 8 metres of sand and thus involved an almost impossible task. The only way to carry out this work was to do it in the dry. Before building the lock, the lock gates were finished in order to use them as cofferdams, the special grooves to accommodate them being built at the entrances. The inner gate was heavily damaged and was jammed in the shut position; the reserve and outer gates were intact. Owing to this happy combination of circumstances, the lock could be rapidly pumped out so that work could proceed in the dry.

The restoration of the inner gate, its re-erection in the groove which had previously been cleared, and transport of the reserve gate to the groove of the downstream cofferdam, were carried out under the best conditions by the French Works Department between August and December, 1946. These very complicated operations were under the direction of Monsieur Grenet, chief engineer of this concern.

While these works were in progress, the Northern Maritime Service and the firm of Sainrapt and Brice put in hand the reconstruction of the lock. Definite ministerial instructions had been given that the Watier Lock must be opened to traffic by October, 1947, at the latest. A rapid survey proved that complete reconstruction of the lock should not take more than two or three months longer than temporary repair, on the assumption that the date on which the lock would be restored to service would depend on the completion of clearing debris in the lock. These works turned out to be much more difficult than had been originally estimated and were finished actually only after the lock had been filled with water. During the progress of the work the decision was taken to carry out the reconstruction work on a permanent basis.

The need for economy in the use of cement, steel and aggregate compelled the use of sheet piling and systematic use of pre-cast concrete methods. These works involved 160,000 cubic metres of embankment filling, more than 35,000 cubic metres of concrete, the removal of 7,000 tons of steelwork in less than nine months; and the erection of 219 pre-cast concrete trestles, each weighing more than 20 tons, in less than a month-and-a-half. These results reflect great credit upon the Sainrapt and Brice concern who collaborated fully with the Northern Maritime Service; in spite of three very severe winters, they successfully completed the work entrusted to them.

Traffic through the Port of Dunkirk remained constant at between 30,000 and 40,000 tons a month up to September, 1947, after which it grew very rapidly, reaching 134,000 tons in December, 1947; 151,000 tons in January, 1948; and to 170,000 tons in February, which was slightly more than 50 per cent. of the average monthly traffic of the period 1930 to 1939. With progressive reconstruction of its quays and the re-establishment of its oil-handling facilities, the Port of Dunkirk should rapidly recover the prosperity which it enjoyed between the two world wars.

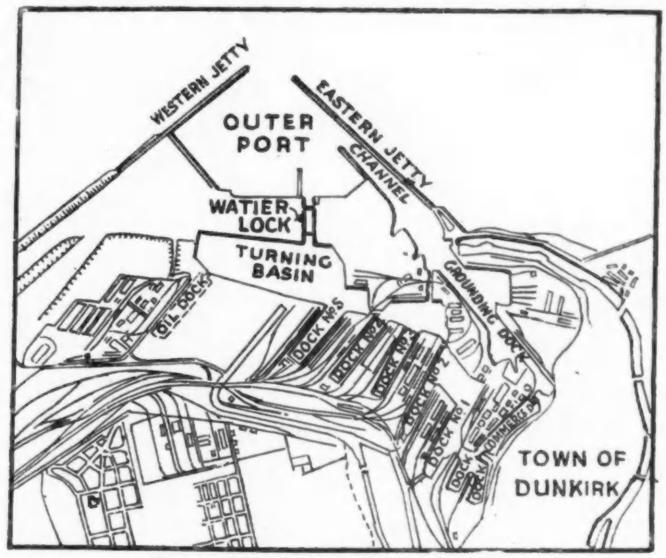


Fig. 1.—Plan of the Port of Dunkirk.

Description of the Lock War Damage and Reconstruction Works by Louis-Pierre Brice.

The outer Port of Dunkirk covers an area of 80 hectares and is bounded on the west by a breakwater founded on rock, on the east by a reinforced concrete breakwater founded on caissons which were sunk with compressed air and which extend the original eastern jetty, and on the south by new embankments. This outer port is connected to the main port by the original channel and by the new Watier Lock. This lock provides access to the new basin which extends the Port of Dunkirk towards the west. After Ymuiden and Emden, it is one of the largest locks in Europe.

It was built between 1930 and 1936 and comprised two concrete entrances with lock sides of steel sheet piling. Its length in the clear (see Fig. 1) was about 288 metres, and its effective width about 40 metres. The bed level of the lock was 8 metres below datum. High water of spring tides was 7.15 metres above datum, the corresponding water level being 0.45 metres above datum; the two entrances are in mass concrete, the bottom of their foundation being 12.50 metres below datum and the sheet piling forming the sides of the lock being driven down to 24 metres below datum.

The outer entrance has two grooves: one for the dock gate normally in service, the other for the reserve gate, thereby permitting repair or duplication of the gate. This outer entrance covers an area of about 110 metres by 75 metres and accommodates

*Abridged translation by Rolt Hammond, A.C.G.I., A.M.I.C.E., of articles by Messrs. Le Gorgen, Chief Engineer of Bridges and Roads; Louis-Pierre Brice, Engineer of Arts and Manufactures in TRAVAUX, No. 163, May, 1948—pps. 259-272.)

The Port of Dunkirk—continued

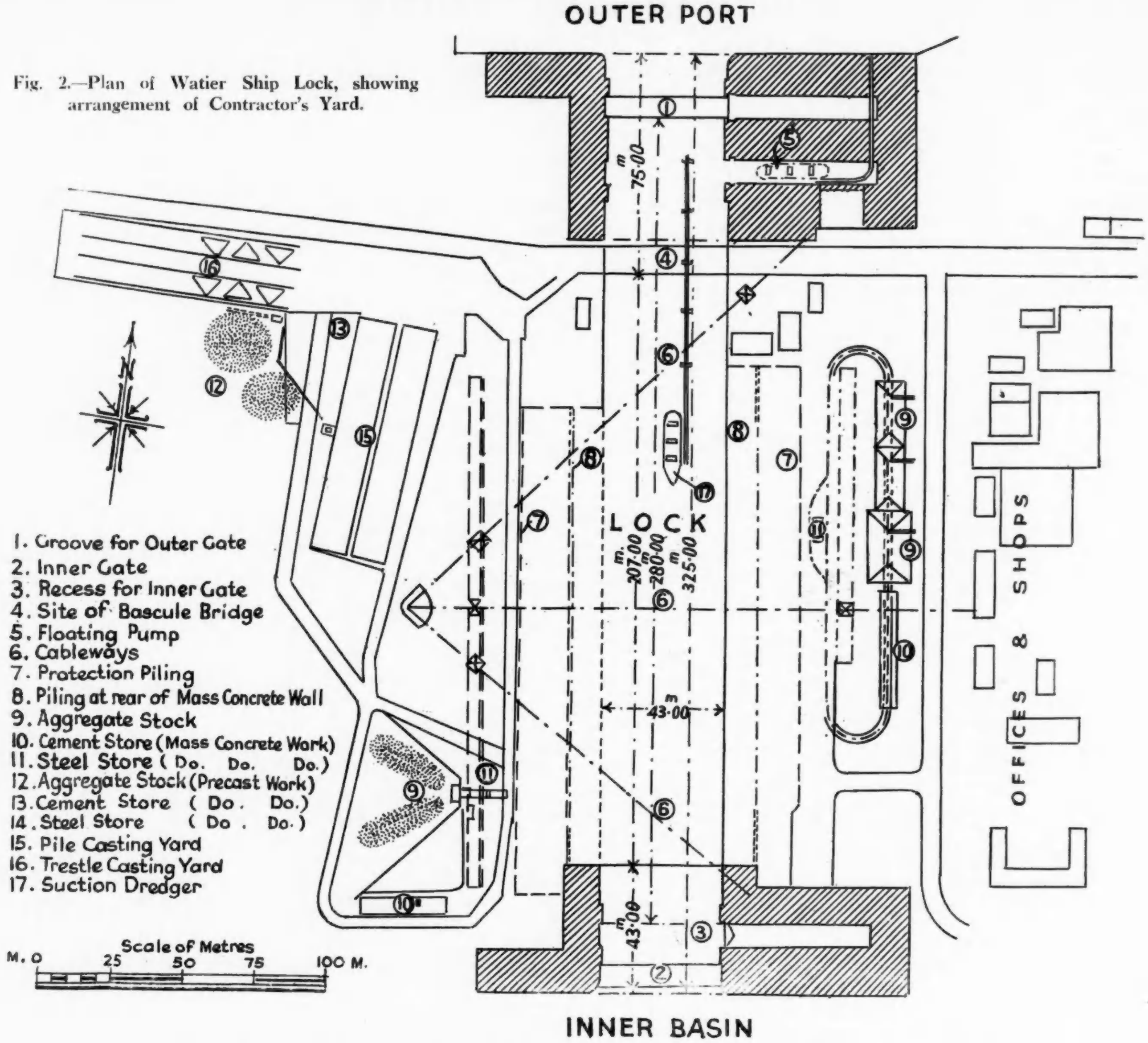


Fig. 2.—Plan of Watier Ship Lock, showing arrangement of Contractor's Yard.

the water circulating ducts and the foundations of a bascule bridge; the inner entrance has a groove for only one gate and the water ducts, covering an area of 110 metres by 43 metres.

The lock itself was completely destroyed and was of much lighter construction, comprising two lines of Larssen No. 2 steel sheet piling 20 metres long, driven down to 15 metres below datum, or 7 metres below the bottom of the lock. Fig. 3 shows a cross section.

The sides of the steel sheet piling were held in place by three layers of tie rods: the lower layer was of 95 mm. diameter bars spaced at 0.92 m. centres attached to the sheet piling and sheet piling anchorage. This latter sheet piling was composed of Larssen No. 5 section 5 metres long and driven down at a distance of 25 metres back from the steel sheet piling of the lock. The middle layer of tie rods consisted of round bars 70 mms. diameter spaced at 1.84 metres centres and fixed to the main sheet piling, and to the anchorage piling; finally, the upper tie rod was 48 mms. diameter spaced at from 3.20 to 4 metres centres, fixed to the coping of the lock and to the anchorage piling.

Damage inflicted on the port works was relatively light at the beginning of the war, in spite of the important historical events which were being unfolded. The Germans however, were responsible eventually for heavy damage before their departure in 1944, their object evidently being to paralyse port activity for as long a period as possible, since this port provided direct access to Germany.

The three locks of the Port of Dunkirk were out of action. Their gates being destroyed, the tides entered the port unhindered; within the Watier Lock some 21 various craft were sunk and 320 metres of the 414 metres of sheet piling were totally destroyed. This had been carried out as follows: charges were exploded on the top layer of tie rods at a level of about 4 metres above datum, resulting in the tie rods being broken and the sheet piling being bent as shown. Under tidal action sand was deposited up to a level of about 1 metre below datum. The massive concrete entrances of the lock suffered only slight damage.

This was the unfortunate state of the large lock after the liberation of Dunkirk. In order to avoid any extension of damage, it was decided to drive rows of sheet piling well behind the original anchorage piling in order to retain the sand embankments. This preliminary work was carried out with American Hoesch piles and was finished by April, 1946. Meanwhile, it was necessary to find a solution which would allow the Port of Dunkirk to undertake

The Port of Dunkirk—continued

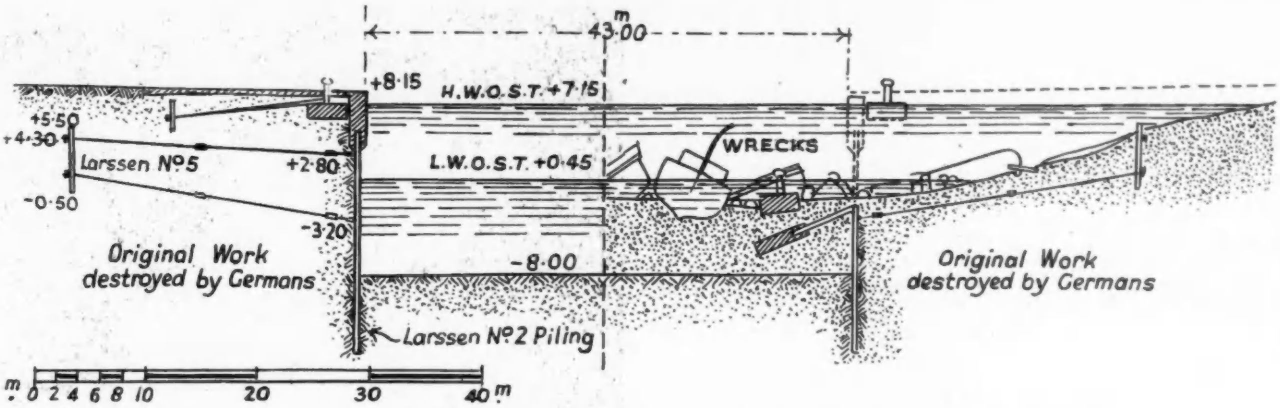


Fig. 3.—Cross-section of Lock, showing original work and after destruction by the Germans.

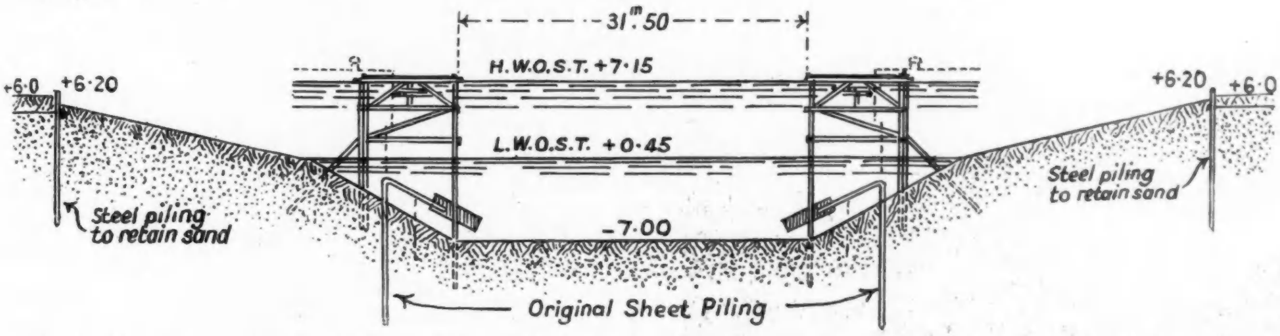


Fig. 4.—Cross-section of Lock, showing staging and piling of scheme for temporary repair, and state of original sheet piling.

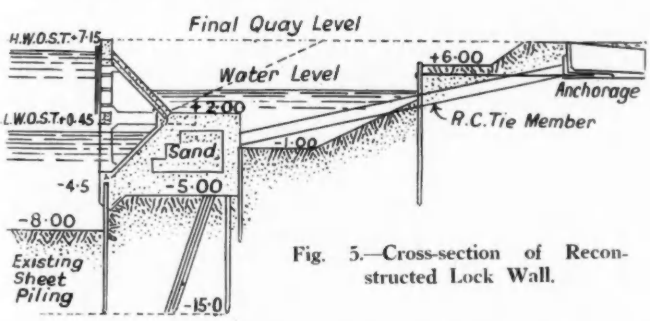


Fig. 5.—Cross-section of Reconstructed Lock Wall.

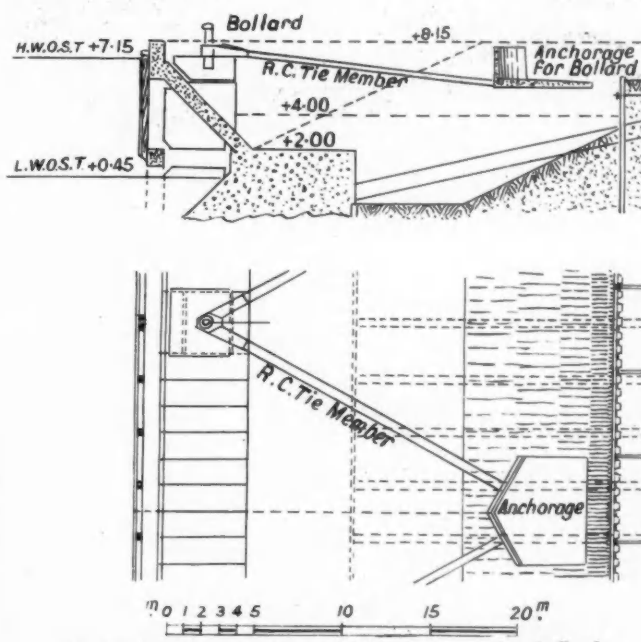


Fig. 6.—Arrangement for anchoring the mooring bollards.

limited work because its operation was entirely dependent upon the functioning of its locks. The Department of Bridges and Highways was therefore instructed to restore the Watier Lock to service, if only on a temporary basis.

Two lines of timber piling, the outer line to prevent side slips and the inner braced to form temporary lock sides, were therefore constructed, as shown in Fig. 4, but difficulties soon became apparent. It was found impossible to cut off the damaged sheet piling under water owing to the strong tidal current. Dredging was inefficient, owing to the continual silting up caused by this same current, and it was therefore recognised that the only possible solution was to work in the dry by closing the lock at each end. Meanwhile, this operation could be carried out only when the other locks of the port could themselves be shut, thereby eliminating the strong tidal currents filling and emptying the whole port through the Trystram Lock.

It was not until August, 1946, that the outer gate of the new lock could finally be shut because it and the Trystram Lock had to be closed at the same time. Drying out of the lock was then dependent upon the erection of the spare lock gate at the inner entrance. Up to this date it was thought that it would be possible to carry out in a reasonable time a temporary repair of the lock, but it was soon found that such a procedure would take as long as work of a permanent character.

It was therefore considered desirable to stop the work of temporarily repairing the lock and to work out a plan for reconstructing the lock on a permanent basis.

Three cable ways of 20 tons lifting capcity and 130 metres span had been erected, as shown in Fig. 2, for the purpose of transporting material for the temporary scheme of repair and their existence

The Port of Dunkirk—continued

in a great measure decided the design and organisation of the permanent repair work which was eventually agreed upon.

The simplest solution to the problem, which would have involved reconstruction of works similar to those destroyed, was impracticable owing to the large quantity (4,500 tons) of steel sheet piling required, none of which could have been recovered from the site. It appeared more reasonable to use the lower part of the original sheet piling and to build a reinforced concrete structure upon this which would have, among other things, the advantage of a large mass and increased resistance to accidents. The only part of the original works being the lower portion of the sheet piling, a type of structure had to be designed which would transmit only vertical load to the latter.

A special type of structure was therefore envisaged, the heavy weight of the rear portion being supported by inclined piles which would be also capable of successfully resisting lateral earth pressure. On the other hand, the front of the structure had to be as light as possible in order to avoid imposing heavy vertical load on the sheet piling.

On the basis of these principles, a number of designs was investigated and it was finally decided to adopt that shown in Fig. 5; the concrete mass is of trapezoidal form with a base of about 12 metres and a height of about 7 metres. Design was as simple as

General view of Lock immediately after sabotage by Germans.

possible in order to facilitate construction. Anchorages provide additional stability which would be assured even without friction below the foundation. The total weight of the work per lineal metre at low tide is about 235 metric tons, assuming a surcharge from earth pressure of 2 tons per sq. metre. The corresponding load on the front sheet piling is 82 tons, and on the rear inclined piles 63 tons. The horizontal component of the latter is 40 tons which is in direct opposition to the earth pressure. In order to provide the necessary resistance to the total load of 66 tons, tie rods have been included in the design and these are anchored as shown. The anchorage blocks can resist a load of 16 tons by friction, the co-efficient of friction being 0.30, and a further 10 tons by thrust against the embankment.

The tie members are composed of 6 rods each of 40 mms. diameter surrounded by concrete 1 metre deep and 45 cms. wide. They are spaced at 3 metres centres and can support a load of 80 tons. The use of reinforced concrete tie rods has enabled nuts and screws to be eliminated. The most original feature of the work was the pre-cast concrete side wall members shown in the photographs, erected with a space between each of 1.50 metres.

In order to avoid the construction in situ of these members and thereby to reduce site work to a minimum, they were all prefabricated. Each one was of identical design, having the form of an isosceles triangle with a base of 10.20 metres and a height of 5.70 metres. The front vertical struts have a cross section of 1 metre by 35 cms. These members were designed to facilitate construction and transport and erection under the simplest possible con-

Suction Dredger clearing channel prior to closing of the Lock.

ditions. They are joined to the mass concrete at the back by eight horizontal reinforcing rods 20 mms, in diameter, four rods of 32 mms. diameter providing reinforcement between the vertical strut and the coping of the lock. The base rests in a groove in the mass concrete of the main foundation; three lifting points were provided so that each prefabricated member could be lifted into place conveniently. These lifting points are short lengths of pipe set in the concrete.

The vertical struts and their abutments have been calculated to withstand a horizontal thrust of 100 tons, being the shock imposed by a ship coming alongside.

Fig. 6 shows the arrangement for anchoring the mooring bollards, the pull of the mooring rope being transmitted to L-shaped anchorages through a sloping tie members of reinforced concrete.

The work of reconstruction involved four distinct phases, namely:

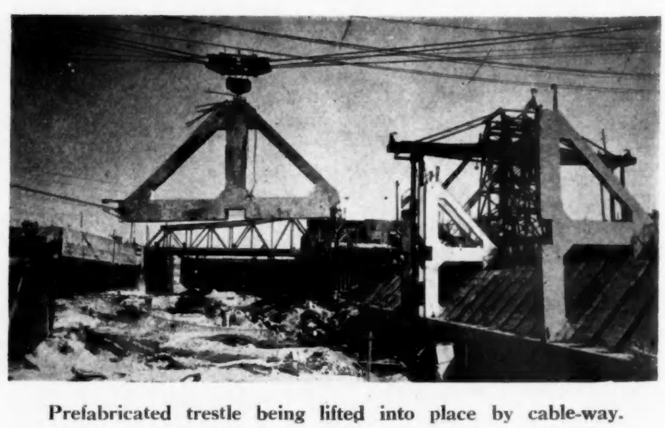
(1) Clearance of lock and removal of debris, including cutting of sheet piling.

(2) Foundations of side walls, embankment construction and pile driving.

(3) Placing of concrete in foundations of walls.

(4) Casting and erecting the pre-cast concrete super-structure.

General layout of the works followed standard practice: a machine shop, carpenter's shop, store and offices. Piped water was supplied to the various concrete mixers and an electrical installation with transformer gave a total of 500 kVA at 380-volts and 750 kVA at 220-volts. On each side of the works there was a 220-volt and 380-volt power line; the former was used for lighting



Prefabricated trestle being lifted into place by cable-way.

The Port of Dunkirk—continued

the works during the night shift. Compressed air was supplied by two fixed compressors, one of 120 horse-power and the other of 60 horse-power, in addition to four mobile compressors of 45 horse-power.

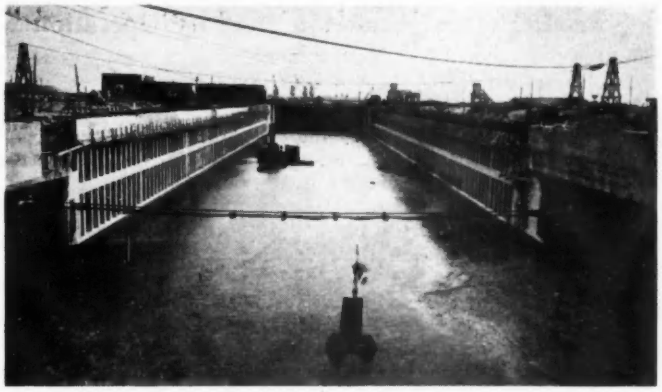
Removal of the debris in the lock was carried out by the three 20-ton cableways, each comprising a pair of carrying cables of 50 mms. diameter haulage cables of 25 mms. diameter, and provided with a bogie having a travelling speed of 20 cms. per second and a lifting speed of 15 cms. per second.

After the three lock gates had been closed the pumping installations consisting of three pumps having a capacity of 2,500 cubic metres per hour, commenced work, operated by motors of 200-250 horse-power on a barge floating in the groove for the outer spare dock gate. as shown in Fig. 2. A single pump generally sufficed, the output being about 500 cubic metres per hour; sand in the lock was removed by a suction dredge having an output capacity of some 200 cubic metres of sand an hour. One pump was operated by a motor of 85 horse-power, the other by a motor of 45 horse-power; together, these were able to pump sand to a height of 5 metres and to distance of 400 metres. Embankments were formed by two scrapers of 7 cubic metres capacity drawn by caterpillar tractors in conjunction with four grab cranes with bucket capacities ranging from 400 to 750 litres. Larssen II and III piles were driven by four piling hammers from 2 to 3 tons in weight.

There was a double concreting installation; one on the east, another on the west. The former consisted of two Kaiser mixers with horizontal drums having a capacity of 1,000 litres. Two concrete pumps were used for placing the concrete, a third being held in reserve. The western installation was an automatic Hubbs equipment. Each concreting plant had an output capacity of about 300 cubic metres a day.

The pre-cast side wall members were transported to the site by the cableways and erected by means of special travelling cranes.

Removal of debris from the lock began on December 20th, 1946. This work was seriously interrupted by frost during the severe winter of 1946-47. The water in the lock was lowered very gradually, and cutting of the steelwork began when the wrecks were uncovered. Fifteen flame cutters were employed twenty-four hours a day. Of twenty-one wrecks, only two were able to be floated; steelwork was cut into pieces less than 3 tons in weight



General view of Lock, showing cable towers and finished work.

and transported to a stock yard by crane, lorry or cableways. The clearance of the old lock involved the lifting of 335 timber piles, the cutting of 6,713 tons of steelwork requiring 140,000 hours of labour, 2,500 bottles of oxygen and 25 tons of carbide, the demolition of 1,700 cubic metres of concrete and the raising of 62,000 cubic metres of debris.

In building the embankments up to quay level, which followed after the lock was opened and in use a volume of about 100,000 cubic metres of material was involved, and although this volume was not very large the working conditions made the task somewhat complicated. Successive stages were involved, and in this the process of ground water lowering was successfully employed. The first series of bore 3 metres deep were spaced at 4.50 metres centres, enabling ground water to be lowered to a depth of 1 metre below the surface; a second series of bores were 8 metres deep and spaced at 8 metres centres. All these bores were inter-connected and suction in each case was regulated by a valve. Each bore was lined with a steel tube of 30 cms. diameter, provided with a large number of small holes, surrounded on the outside by pea-size gravel to prevent the access of fine sand.

Construction of the sides of the lock proceeded normally; there were three rows of piles driven beneath the foundation, 182 of them being vertical and 674 raking. Pile-driving was carried out by 3-ton hammers using water jets to help driving to a depth of from 8 to 9 metres, to a set of 15 mm after 10 blows with a fall of 50 cms, corresponding to a bearing capacity of 80 tons as calculated by the Dutch formula. At some points bending of the sheet piling had caused displacement at the bottom, and there it was necessary to modify the cross section of the new lock. Where such displacement did not exceed 30 cms., no modification was necessary. For greater local displacement, additional piles of reinforced concrete were driven, at the back of the existing sheet piles.

Manufacture of the concrete piles presented no special difficulty except that under harsh winter conditions 300 piles were made under cover, 45 of them embodying ciment fondu because of the urgency with which they were required. The form and reinforcement of the pre-cast concrete trestle front units, were designed with a view to ease and speed of manufacture and erection; they were cast in stacks of five on a concrete storage ground. The inner shuttering was of timber for the full height of the five units laid flat; the outer shuttering was of steel plate. Proportion of cement was 350 kgs per cubic metre, grading of the aggregate being adjusted to provide maximum density of concrete. Reinforcing bars were bent in accordance with standard practice and 219 pre-cast units were made and erected.

Some 30,000 cu. metres of mass concrete were poured in a 100 days. Concreting being carried out in lifts, from 1.50 to 2 metres in depth. Maximum rate of placing mass concrete was 1,500 cubic metres per week for each of the two sides. Erection of the pre-cast trestle units proceeded apace owing to the special devices employed; i.e., the cableways and transporter cranes; the maximum number placed in a fortnight being 84.

General view of Foundations, showing existing piling, foundation slab and cable-way towers.

Buoyage and Navigational Lighting

An Important Function in Port Operation

By CAPT. H. V. HART, R.N.R. (Retd.).

In certain ports, the responsibility for the establishment, operation, and maintenance of the necessary buoyage, and navigational lighting services, within the area of the port, is vested in the Port Authority. In such cases, this undertaking is subject to the sanction of the appropriate lighting authority, within whose area, the port is situated, for all alterations, etc. of buoyage and lighting, which may be contemplated. The three lighting authorities for the U.K. are:—Trinity House; Northern Lights Commissioners; Irish Lights Commissioners. An inspection of all lights within their respective jurisdictions is periodically made by these authorities, with a view to ensuring satisfactory maintenance, and general efficiency of all such lighting.

Buoyage and navigational lighting presents separate and particular problems to each individual port, according to its geographical position; hydrographical features; and volume and peculiarities of shipping trades, for which, it especially caters.

Ports may roughly be placed within three categories, as follows:—

1. Those situated on a river, or estuary, and distant from the sea, and possessing lengthy and intricate channels to the port.
2. Those situated on a river or estuary, and possessing short approach channels to the port.
3. Those (harbours) situated practically directly on a seaboard, without appreciable approach channels to the harbour or port.

The first case obviously necessitates an extensive and distinctive system of buoyage and navigational lighting, and probably entails as a component part of such system, the addition of one or more lightvessels. These will be (a) for the purpose of providing a substantial floating navigational mark at the seaward entrance to the approach channels, to assist vessels, when inward bound, in making a satisfactory landfall.

(b) To provide efficient and distinctive navigational lighting, and fog signals for arrival off the port entrance, and for during passage through the channels.

(c) To divide inward and outward traffic through the channels at salient points.

(d) For the exhibition, when necessary, of special signals; for the issuing of warnings to shipping, etc., if and where, required; for the immediate observance and reporting to the Port Authority's responsible department (marine) of any casualties occurring to vessels, and/or buoys, lights, etc., or of any other special events.

In case 2, the requirements will permit of considerabel modification, and in ports of such geographical features, due regard must be paid to the possible provision of existing coastal lighting, in the form of a lighthouse, in the near vicinity of the port, which, would further reduce navigational lighting requirements.

In case 3, these will be confined to the provision of suitable identification, and entrance lighting to the harbour, or port. Navigational lighting may be divided into 4 separate and distinct entities, viz.:—(a) Lighthouses (coastal, or situated at some distance from the port, and especially for that particular port). All actual "coastal" lighthouses are provided and administered by one of the above lighting authorities, and it is therefore exceptional for any Port Authority to operate any lighthouses, which can be considered within the definition of "coastal."

(b) Lighting of channels, etc., comprising light-vessels, buoys, etc.

(c) Lighting of estuary, or river, comprising entrance shore lights, in the form of small lighthouses (usually unwatched); buoys, as requisite; distinctive lighting at salient points.

(d) Distinctive lighting at all river entrances to docks; lighting on all stages, jetties, wharves, laybyes, etc.

For the purposes of this article which deals exclusively with port operation of navigational lighting, the subject of lighthouses will therefore be ignored, and remarks will be confined to the remaining forms of general lighting.

In considering the buoyage of a port, the primary and essential requirement is, of course, a complete and detailed survey of the area to be buoyed. This, in the first instance is provided by the Admiralty chart of the locality, but in many cases, it will be found necessary to supplement this, by a periodic survey of considerably augmented scale, by the Port Authority.

Buoyage—General Principles

The extent of buoyage necessary—i.e., the number of buoys required for efficient marking of a channel, depends upon the features of such channel, with regard to the general and minimum navigable widths and depths; and whether the channel adopts a straight; acute angled turns, or sinuous form. A wide straight channel requires the minimum number of buoys, but in no case however, if possible, should the spacing of buoys exceed half a mile. This, is to conform to general conditions of navigation which continues until range of visibility is reduced to that distance, and below which, it is not actually considered prudent to navigate buoyed channels. Buoys should, as far as possible be interspaced on opposite sides of channels. The existing uniform system of buoyage—i.e., red conical buoys, with white lights to starboard; and black can buoys with red lights to port (from seaward)) will shortly be replaced by the new system, in accordance with the recent International Convention, when, buoy colours will be reversed, so as to embody the principle of red buoys—red lights; and black buoys "white" lights. Logically, of course, these latter lights should be "black"! The identification system will also be changed, when odd, and even numbers will be placed on opposite sides.

In subsidiary channels, where traffic is principally limited to daylight navigation, owing to restrictions of width and depth, by coasters, dredgers, and other small craft, it is possible to reduce the number of lighted buoys by their interspacing with unlighted ones. This, however, is not entirely satisfactory, as it is productive of casualties to the latter type of buoys. In such channels too, it is customary to use a smaller type of buoy (termed second class) in place of the usual first class 10-ft. base buoy.

In certain ports of the world, a system of central channel buoyage has been adopted. This, of course, consists of a centre line of buoys only. By such means, a great economy in the number of buoys required, is effected, but it possesses the dual disadvantages of failing to indicate the extreme lateral navigable width of a channel, and also, offers inducement to the human failing to "stick to the middle of the channel" between buoys, with consequent additional risk of collision between opposing vessels.

In some cases, too, pile erections are substituted for buoys. These, are naturally subject to severe limitation in number, and are only possible where stable foundations exist, and where, sudden and extensive fluctuations of depth, as the result of shoaling, are non-existent. They possess the advantage of immunity from removal from station, by weather conditions, but fail to exactly outline the limits of minimum channel depth, owing to the difficulty experienced of dredging in their immediate vicinity.

Particular Buoyage

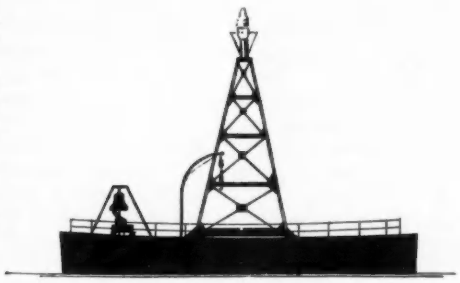
In ports, subject to maximum tidal ranges, and where, shipping traffic is largely comprised of large vessels, with an extreme "Height of Eye" on the bridge, it has been found necessary to provide a type of buoy, with ability to carry a greatly increased focal height of light, to cope with the severe inclination of the ordinary buoy to tidal effect. The light becomes partly obscured to the observer on the lofty bridge of a very large vessel proceeding against an adverse tide, and seriously detracts from its full range and visibility. This has been obviated by the substitution of boat beacons for buoys, in many instances. These beacons are boat-shaped and approximate dimensions of 40-ft. x 10-ft. x 4-ft. and are in three separate W.T. compartments. They carry the appropriate superstructure and a larger-size lantern with a focal plane of 35-ft.

Radar Buoys.—With the advent of Radar, a new type of superstructure for the conventional circumferential plated conical buoy has been evolved. In this, the superstructure consists of 4 light-angled vertical plates, fitted so as to present a conical form from all points of view. These plates are slotted towards the base, to

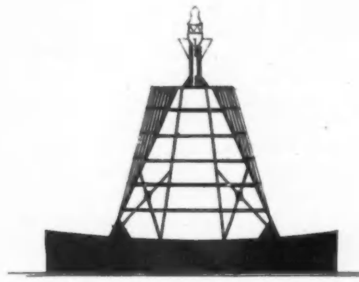
Buoyage and Navigational Lighting—continued

minimise damage by seas, and are interconnected by three horizontal interspaced plates. This form of buoy increases Radar range of the modern "shipset" by about 50%.

All channel buoys should be in alignment with one another as far as possible, in order to assist the navigator in setting straight courses in thick weather. Buoys, in a channel bend, should conform as nearly as practicable to a regular curvature. Irregular dispositions and alignments constitute a risk of damage to buoys and vessels. It is desirable to uniformly "pinch the channel," for some distance rather than to adopt a practice of irregular bouyage. with projections into the channel.



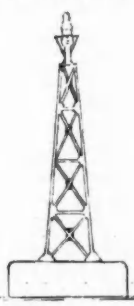
55-ft. Boat Beacon



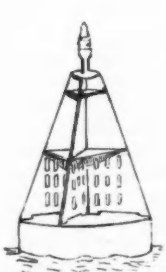
35-ft. Boat Beacon

Moorings.—These, form an important item in buoyage, as upon their efficiency, depends the correct station maintenance, and safety of the buoy. Moorings consist of lengths of approximately 1⅝-in. chain, attached to mushroom 30-cut sinkers. Boat beacons require large sinkers, and those of square form, and 50-cwt. in weight have been found suitable. In certain cases a "backing" length of chain and sinker are found necessary. The length of chain must be proportionate to a combination of—depth of water; tidal velocity; and position with regard to exposure to weather. All pins of connecting shackles should be cold rivetted. Severe weather is the most prevalent cause of "parting," but long spells of "quiet" weather cause "hammering" of links and loosening of shackles. Where the bottom fluctuates, severe "sanding" is usually caused to the mooring, which eventually "pins" the buoy, and causes "parting." Correct maintenance also depends upon good "holding ground." Mud and sand, are good, apart from "sanding" proclivity, but clay and shingle, etc. are unsatisfactory, and great difficulty has been experienced in one port, in maintaining the station of a particular buoy over this form of holding ground. The consequences of breaking adrift may be serious, both to the Port Authority, and to shipping, as a monetary loss, and a navigational menace, respectively. On a certain occasion, and in the above port, no less than 9 buoys, and/or beacons became simultaneously adrift after a severe gale. One of these was eventually recovered from Ireland; another stranded 50 miles from the port, and was refloated, and returned at a cost of £500; and a beacon was driven against a neighbouring seaside promenade wall, and damaged it, to the extent of several hundred pounds. Another form of damage, chiefly, but not exclusively confined to isolated buoys, resulted from the exhuberance of spirits of youthful British airmen during the late war, to whom, buoys, presented an irresistible target for machine gun practice!

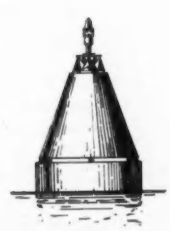
It must be remembered—when placing buoys, and when navigating close to shoal water, that the buoy swings with a radius of from 100-150 feet. It is most important for a Port Authority, not only to maintain buoys in their correct chartered positions, but also, to keep a continuous and strict record of all the several "fixes," by which, such positions are verified. These "fixes," or any other means of position determination, should be entered on all occasions, in a special "Buoy Book," in which too, it will be found convenient to include the "history" of each buoy therein. This constitutes a valuable record "against possible future litigation"!



Pillar Buoy



Radar Buoy



Radar Buoy alternative type

Wreck Marking. This is a most important part of buoyage, as any laxity, or inaccuracy in marking a wreck, may result in a serious shipping casualty, and consequent financial loss to the Port Authority. Emergency wreck buoys should be kept in an accessible place, in readiness for placing on station at the shortest notice. It is advisable too, that the Port Authority's tenders should be equipped with a complete set of wreck marking signals, lights, etc., in order to be able to proceed to a wreck at the first intimation of such, and take up the requisite position as a temporary wreck marking vessel, until the final marking is effected. Previous to the completion of the latter operation, it is essential to obtain exact information of the "lie," and orientation of the wreck.

The wreck mark is placed to seaward, but in a tidal waterway, and where much traffic exists, it is often advisable to place an additional mark on the opposite side of the wreck, as a warning to outward traffic. In certain cases, where a large wreck is lying athwart a fairway, it becomes necessary, in addition to foregoing marks, to place marks at each end of the wreck. In localities where fog is prevalent, a mark, in the form of a wreck marking vessel, or bell beacon, as capable of giving audible warning to shipping should always be used whenever possible. Wreck marks should be placed as close as practicable to wrecks, with due allowance made for the swinging radius of the mark, and sufficient latitude, to avoid fouling of the mooring on the wreck. Wreck marking vessels should always be moored, in "close waters," in order to "cover" the wreck as closely as possible.

A warning! Whenever "dispersal" of a wreck has taken place, and before the wreck mark has been removed, and the wreck declared as "clear," to the desired depth, the most stringent precautions must be observed to ensure that **no part** of the wreck remains above the required depth. The only really reliable method of obtaining this certainty, is that of "sweeping" with meticulous care over the entire area of the wreck, by means of a long steel bar suspended beneath a vessel, at the exact depth required for complete dispersal. The consequences of any neglect in this respect may prove extremely serious to the Port Authority.

Lighting.—A simple, usual, and generally, one of the most satisfactory systems of lighting, is the establishment of single-flashing marginal lights in a channel, with distinctive quick flashing, or group flashing lights at salient points.

The range of characters, from which choice can be made are:—

Flashing; group flashing—with variations; occulting. The latter is to be deprecated, as other than an occasional feature, owing to the excessive amount of gas consumed, with consequent need for more frequent replenishment. This particular character of light is also of more limited range and distinction, than a flashing light.

The choice of operative energy for lighting includes:—

Coal gas; electricity; acetylene gas. The first named requires replenishment at frequent intervals (approximately 6 weeks) and is now virtually obsolete.

The electric source, as applied to self-contained buoys, is comparatively new, but becoming progressively established in certain ports, and has been claimed as satisfactory.

The acetylene gas system of lighting as supplied by the "Aga" Company has been in use, all over the world, for a great number of years, and has been proved its extreme efficiency and reliability.

The gas containers are capable of maintaining a 15 months'

Buoyage and Navigational Lighting—continued

supply of gas, but it is customary to replace them after 12 months on station.

The approximate usual frequency of a flashing light is that of:—light 1½-secs.—dark 3½-secs., i.e., 12 flashes per minute. A most satisfactory frequency is that of:—1-secs. light—1-secs. dark, i.e., 60 flashes per minute. This latter is peculiarly suitable for establishment at salient points in channels, and remains entirely distinctive among other flashing lights. It is also useful when interspaced between other buoys in long channels, as a check for the navigator on his position, with regard to the number of buoys passed by his vessel. Group flashing lights at intervals also serve the same purposes. A form of the latter characteristic which has appeared under several designations, including the term " scintillating," is a 240 flash per minute, in group formation. This is particularly suitable for use in isolated positions, where, long range visibility is not required. The range of flashing lights should be 5-6 miles. With regard to colour the choice is necessarily limited, and white and red, remain predominant, as green is excluded from all floating marks, by its reservation for wreck marking purposes only. From time to time, experiments have been made with both amber and blue lighting colours. The latter was used for some time previous to the late war, by a great port, for the buoyage of a small half-tide channel, for small craft. This coloured light gives poor exhibition, with a maximum range of about ¾ mile, and is severely affected by conditions of low visibility. Amber lights were also tried by the same port, but rejected on account of their doubtful discrimination between that colour and white.

Modern lighting provides (almost) complete immunity from former troubles in connection with carbonisation and mechanical faults of flasher, etc. and the percentage of buoy light failures should not exceed 2% or 3% per annum.

A most unusual cause of " supposed " light failures occurred several years ago, in Liverpool Bay, shortly after the introduction of a revised system of buoyage, whereby the can buoys were replaced by boat beacons.

Constant reports were nightly received by the Port Authority, as to the extinction of lighs on these boat beacons, which reports, upon inspection by the tender, of the beacons referred to, proved unfounded. This trouble was experienced for a considerable time, until it was eventually discovered that large numbers of " cormorants," which, up to that time had been non-existent in the bay—had suddenly invaded the locality, and were in the habit of perching upon the platform around the base of the light, and spreading their wings, for drying-out purposes (?) and thus completely obscuring the light. This trouble was overcome by festooning wire upon small uprights fitted around the lamp.

In connection with lamps—it may be noted that in cases where a buoy breaks adrift and strands upon a foreshore, it is highly advisable for the Port Authority to remove the lamp at the earliest possible moment, because it is most extraordinary.

(1) Where boys come from.
(2) Where stones come from.
(3) What an irresistible target is presented!

Reduction of ranges of lights.—It may be of interest to briefly describe the method adopted in Liverpool, during the late war, of reducing the visibility of buoy lights. The device, which was the result of several months of pre-war experiment, was devised and produced by the marine department of the Mersey Docks and Harbour Board and consisted of a circular tin shield, or screen, perforated with a series of holes of various diameters, to suit the different ranges required. Their screen fitted inside the lamp glass, and supplies were made to reduce the existing range of 5-6 miles, to standard ranges of 2 miles; 1 mile; and half mile. The cost of this device was negligible.

Spares—stock.—As part of a buoyage undertaking, it is necessary to maintain in stock, as reserves for normal routine change, casualties, losses, etc., a certain number of each form of buoy, although in certain instances, the superstructures can be made interchangeable between different types of buoy. The normal percentage of such reserves, carried by a Buoying Authority is in the region of 30%, but since the late war, this has considerably decreased in most cases, owing to the high cost, and difficulty of replacement.

Buoy, depot or store.—Buoy maintenance is both expensive and exacting. The necessary Port Authority Tenders, for attention, and periodical changing of buoys, etc. must be available, and at short notice, at all times. In addition, the Authority must provide a fully-equipped depot or store, capable of dealing with all the ramifications connected with repairs and maintenance, and storage for the large amount of stores and materials required. Such depot should be in a position of easy access to Tenders, and with like facility to a dock, where beacons and lightships are normally kept, when off station. For the sake of convenience and safety, the store should be equipped with an overhead travelling gantry crane, capable of lifting and transporting all buoys, the weights of which, for first-class buoys, vary from 8-12 tons.

Adequate stocks of moorings must be maintained and ready ranged for quick shipment to buoyage tenders, and spare lamps of each type employed, must be periodically tested, and kept in continuous readiness. The normal period between buoy changes is 12 months, and when brought off station, all buoys and beacons must be opened up, gas cylinders changed, and buoys, etc. cleaned and repainted. The beacons are dry docked at average intervals of 2 years. Modern methods of power scaling, and spray painting, greatly reduce working hours for the above operations, which are carried out by the store staff, augmented by the lightship crews, who work at the store, during their spells ashore.

All the above, entails a very considerable cost to the Port Authority which operates the buoyage of its own area, and in the case of a large port, in which the total number of lighted buoys on station approximates to 100, the capital replacement value of buoys, etc. alone, is in the region of £250,000.

Lightships, Etc.

The principal functions of lightships have been previously outlined in this article. In form, they vary from the fully-manned vessel of size, exhibiting a powerful light, and equipped with a long range fog signal, to small unmanned vessels, provided with an automatic light and fog signal, the latter being in the form of a bell. The lights exhibited by the former are operated by electricity; incandescent vaporized paraffin; or, acetylene gas, these being generally in descending order of power. The more usual characters of lights exhibited are:—Flashing; Group Flashing; Revolving; with ranges varying from 6-14 miles. The most efficient fog signal is produced by a compressed air driven reed horn, with a range so variable under different atmospheric conditions, as to preclude any definite figure. In connection with the latter question of atmospheric conditions, there are occasionally found certain peculiarities of these, which produce " zones of silence " in the vicinity of a lightship—as doubtless, elsewhere also—such a phenomenon exists in the immediate vicinity of a lightship, on the N.W. coast, where it frequently happens that the lightship's horn is perfectly audible at several miles distant from the lightship, but when approaching her from a certain direction, and when the distance is lessened to about ¾ mile distant, the horn becomes inaudible, and remains so, until the lightship is close-to.

In close, and tidal waters, it becomes necessary for the moorings to consist of 2 " legs," i.e., flood and ebb, and it will usually be found sufficient to allow about 10 fathoms of " slack " on these moorings. In exposed positions, and if moored in this fashion, about 15 fathoms of " slack " will be required. In a certain case, also on the N.W. coast, a lightship in such a position, consistently " dragged " as the result of each severe gale, with lengths of 150 and 120 fathoms on her moorings. Finally, she was found to lie with great improvement, to a longer scope, at single anchor. This latter method is the usual one adopted by coastal lightships, which, veer, and heave in cable, according to the prevailing weather. Additional anchors and cables are carried as a precaution against " parting," It is highly desirable for lightships to be equipped with fog graphs, for the purpose of recording the exact periods during which, the horn, or other fog signal is being given. This is conclusive in refuting any subsequent allegations as to failure to give fog signals during low visibility periods.

Buoyage and Navigational Lighting—continued

Directional W/T forms part of the equipment of modern lightships, which, are also required, in many cases, to fulfil the function of a W/T calibration station.

They should also be in communication with the Port Authority, and other lightships of the port (if any) for which, R/T constitutes the best means.

Lightships will exhibit the appropriate meteorological, and any special signals, in the customary use, in the port, and make constant observation of all passing shipping, and all floating navigational marks, as to their correct positions and functioning with regard to the correct positions of buoys, etc. The lightship's duty in this respect, has been lately supplemented in one large port by the introduction of a port radar installation, by means of which, the positions of all floating marks can be checked at any time. In restricted waters, the small unmanned lightship, or bell boat beacon, is often sufficient to replace the ordinary lightship, but however, the gas-operated bell, as a fog signal, is of limited range.

The following are certain details with regard to the lighting of buoys, boat beacons and lightships:—

Size of buoy lamp on a second-class buoy (millimetres)	140 m/m
Size of buoy lamp on a first-class buoy (millimetres)	200 m/m
Size of buoy lamp on a boat beacon (millimetres) ...	300 m/m
Size of buoy lamp on an unmanned lightship (millimetres)	500 m/m
Candle power of small, obsolete lightship	4,000 c/p
Candle power of modern lightship with incandescent vaporized paraffin lighting and a 55 m/m mantle	90,000 c/p
Candle power of large modern electrified lightship ...	124,000 c/p

Shore Lighting

River Dock Entrances.—These require distinctive lighting on the pierheads, which serves the dual purposes of identifying the entrances, and providing a means of position determination to vessels outside the docks. This lighting is usually formed by a combination of colours, for which green is admissible.

In some cases, and where it is customary for vessels to lie alongside a wall, while waiting docking—lights will be required to delineate dredged areas, outside these entrances, and in which, vessels can lie safely.

Leading Lights.—Where dock entrances have marginal banks, or shoals, leading marks and lights must be provided. In such instances, and in addition to the customary leading lights on each side of the entrance, it has been found advantageous to instal " centre " leading marks, in the form of crosses, etc. which are illuminated on night " tides."

Stage—pier, etc., lighting. These should be lighted at each end, and in common with all works projecting into a waterway, it is important to arrange the form of lighting, so as to provide individual distinction, and also to avoid the possibility—if of a single light character—of it being mistaken—" for the sidelight, or anchor light of a vessel "! Such a precaution appears fantastic but, " it **has** happened "! Lights in triangular form are very suitable for the above. Stages, jetties, piers, etc., at which, vessels are berthed should also be equipped with fog signals, which, usually consists of a bell. This should be deep-toned, with a distinctive number of strokes, to give discrimination between itself, and the fog signals of an anchored vessel.

It will generally be found conveninent for all the above to be electrically operated.

Individual, and grouped mooring buoys, situated in, or near a fairway, should also be lighted. A single white fixed light will be sufficient for the former, but the latter will probably require something more elaborate, in the form of a " covering " lighted buoy.

In conclusion, the need for careful, and continuous observation and supervision of all navigational aids and appliances, within the responsibility of a Port Authority, cannot be too strongly stressed. The Port Authority is the universal mark to be " shot at," whenever possible, when any casualty occurs, and the slightest opportunity exists, for claims in respect of alleged failures or neglect on their part; such claims are often framed on the most frivolous pretexts.

One of the principal qualifications for hydrographical surveying has been defined in the official textbook, as—" an infinite capacity for taking pains." This definition should also be applicable to all conservancy work.

Book Reviews

Dredge Drain Reclaim, by Dr. Joh. Van Veen, Chief Engineer Rijkswaterstaat, 167 pages, with 95 figs., photographs and maps. Crown 4to. size. Published by Martinus Nijhoff, The Hague, Holland. Price 12 guilders (approx. 23s.).

Though Holland is well known for its long and perpetual fight against the water, a book has never as yet been written about this remarkable struggle, not even in the Dutch language. There have been published parts, like the draining of the Zuiderzee and the reclaiming of Walcheren, but not the whole story of dour perseverance over a period of 24 centuries.

This book begins by showing how the " misera gens," described by Pliny as marooned on self-made mounds in a waste of water and mud, developed into a people of hydraulic engineers, seamen and traders, slowly obtaining mastery over adverse conditions. The first ancient dyke laws, the invention of the sluices, the mills and the dredgers, and an amazing use of the spade, combined with the zeal and hard work of its people, has enabled Holland to evolve. Due to the long training in this art of making something out of almost nothing, the people of the low country have been in demand all over Europe since 1100 or earlier; maps show the many parts of Europe and the rest of the world where the Dutch drained, dredged and reclaimed since such early times. It seems as if there is hardly any swamp or coast in which the Dutch have not had a hand.

Though Holland is flat, its history shows high peaks and low valleys. This history of the Dutch, with its great ups and downs, its defeats because of stormfloods and silting, its victories because of invention and perseverance, will be considered by many technical or non-technical readers as more interesting than fiction. It explains, as Dr. Ringers, formerly Minister of " Waterstaat," says in his foreword, some salient points in the Dutch character, and how the Dutch have become " Masters of the floods."

Grundlagen der Wasserbaukunst (Fundamentals of Water Control), by G. Tolkmitt, 228 pp. and 81 illustrations. Published by Wilhelm Ernst & Sohn, Berlin. Price 16 German marks.

The fifth edition of this useful work has just been issued; apart from slight revisions in the text, by Dr. Walther Paxman, there is little change from the original work. It is essentially an academic treatise dealing with the various forms of collection, control and assessment of ground water; the flow of water in channels, and over weirs or spillways. The chapters on the survey of river sections, and the measurement of the average current has not been brought up to date; there is no mention of the modern methods of utilising the improved electrical devices for this purpose. Nevertheless the book provides good ground work for students, of the abler kind, as it deals exhaustively with the technical principles involved.

Der Grundbau (Foundation Soils), by Brennecke & Lohmeyer; 250 pp., 163 illustrations. Published by Wilhelm Ernst & Sohn, Berlin. Price 18 German marks.

This well-known work is also in its fifth edition and well deserves its popularity. For students and civil engineers versed in the German language this volume will be found to contain all the fundamental principles of Soil Mechanics study. The treatment is thorough, and is copiously illustrated by mathematical and practical details.

R. R. M.

Ocean Waves and Swell

by N F. BARBER, Royal Naval Scientific Service*

The military demands of the Second World War have led to a considerable increase in the study of ocean waves. Revised rules showing how the height and period of waves generated in a storm depend upon the strength of wind and its duration have been formulated by the Hydrographic departments in Britain and in the U.S.A. These revised rules are based upon extensive observation and theoretical work done by ships officers and by research workers during the last decade. It is worth pointing out that the rules apply to deep water and that very different rules will probably be needed to predict the waves that wind may generate on shallow water. Engineering work on breakwaters in the Zuider Zee is one project which requires such rules, and model experiments are being made for the purpose in the Hydraulics Laboratory at Delft.

Individual waves in a storm vary greatly in their height and length. For many purposes a measure of the average height and average length is good enough, but recent work has shown that a more precise description of the wave pattern is necessary when the arrival of swell from a storm is to be predicted on a distant coast. The speed with which swell is propagated across the sea is directly proportional to its period. Thus a swell with a period of 10 seconds spreads forward into undisturbed water at a mean speed of about 15 knots and so takes about 3 days to travel 1,000 miles whereas swell of period 20 seconds requires only half as long.

It must be supposed that in the storm area the complex wave pattern is an interference between trains of waves of various different periods and when these wave trains pass out of the storm area they travel at different speeds. The first swell which reaches a distant coast has a long period, often as much as 20 seconds; in the course of half-a-day, the height of the breakers usually increases and the period decreases, as the first swell, which has run rapidly from the storm area, is followed by swell which, although shorter, is higher and contains most of the wave energy created by the storm. To make a detailed examination of the waves reaching the observatory at Perranporth, Cornwall, an instrument has been devised to make a frequency analysis of these records, and the technique has proved most successful. The long swell coming from a distant storm can easily be detected even when it arrives among shorter waves of greater height generated by local winds. The records show the manner in which the period of swell decreases with time. This rate of decrease in period, or the number of hours elapsing between the arrival of ground swell and the later arrival of swell of shorter period, may be used as a measure of the distance from the coast, of the storm in which the swell is formed. In this way the swell received at Cornwall can be associated with various storms revealed on the meteorological synoptic charts of the North Atlantic which are drawn up by the Air Ministry. Swell about 6-in. high has been received from a tropical storm off Florida, nearly 3,000 miles from Cornwall and it has been shown that low swell is regularly received from storms in the neighbourhood of Cape Horn, more than 6,000 miles away. These extreme observations are of importance because they offer a good measure of the rate at which swell travels in practice. In the absence of strong winds the rate of travel is the same as that suggested by theory, but there is some evidence that strong following winds make swell travel more slowly. The effect of opposing winds is not yet known.

The longest waves which are produced in a storm have a period in seconds equal to about one-third of the greatest geostrophic wind speed in knots. The dominant wave in a storm has a period approximately three-quarters of this value. These relations enable the strength of the storm to be inferred from the periodicity of the swell, or conversely, enable the time of arrival of the swell to be predicted when the position and wind strength in a storm are known.

In recent years emphasis has been placed on the behaviour of waves when they reach the coast. There are a number of curious phenomena, such as the refraction of waves by submerged promontories or shoals, or by tidal streams, and there are the more obvious protective effects of headlands and bays. These factors considerably modify the nature of surf and have an evident military importance for coastal landings, but the extensive observations and theory dealing with surf have commercial value in the problems of coastal erosion and the protection of harbours. A recent publication by the U.S. Hydrographic Office gives a useful non-technical description of this subject and of the physics of ocean waves in general.

The arrival of destructive swell can often be predicted some hours previously by the long ground swell that runs ahead of the rest. This may prove to be a useful technique on coasts where harbours are few and where ships must make their lading from shore craft in an exposed anchorage. There are possibilities that distant storms may be detected even before the ground swell arrives. It appears that storms at sea give rise to tremors in the sea bed that detectable at great distances by suitable seismographs. This is especially true of tropical storms. The detection of storms at sea by this means was first suggested by S. K. Bamerji as a result of observations in India, and Lt. M. H. Gilmore, U.S.N., in a research programme organised by the U.S. Navy, has followed by this means the course of tropical storms moving about the Carribean Sea. The ground tremors take the form of an oscillation with an amplitude of some thousandths of a millimetre and a time period of between 3 and 10 seconds per oscillation. They radiate from the sea bed below the storm and travel at a speed of 2 km. per second so that there is very little lapse of time between their commencement in the storm and their arrival at places many hundreds of miles away. By comparing the motions of three seismographs situated at the corners of a triangle about a mile apart it is possible to say from what direction the seismic waves are coming. Two such systems located in different observatories allow the storm to be located by triangulation.

It is surprising that storms can produce motions of the sea bed when this is far below the point to which wave action usually penetrates. It appears most likely that fluctuating pressures on the sea bed are produced when wave trains of similar period travel in opposite directions on the sea surface. This condition may occur in the eye of a tropical storm where wave trains approach from all directions, or in temperate regions in the wake of a rapidly moving barometric low, or where swell is reflected from a steep coast. The seismic technique applies very well to the location of tropical storms. It is yet to be seen whether it can be successfully applied to the location of barometric lows and "fronts." There is some evidence that storms in the North Atlantic can generate seismic signals but that the rythmic "microseisms" observed in Europe come in the main from swell which is reflected from the coasts.

Another possibility is that storms may generate long waves or surges with periods of the order of 10 minutes. If these are generated while the storm is in deep water they will radiate away from it at tidal speed (some 500 knots) and would serve to indicate the presence of the storm to distant wave observatories. Such long waves have been suggested as a cause of the oscillations that develop in large harbours, notably Table Bay harbour. Waves with a period of about 15 minutes but only an inch high have been detected at La Jollia, California, and have been associated with existing barometric lows. It remains to be seen whether this discovery can be used for the detection of storms, but the work is being actively pursued. Methods of locating distant storms would be of great value in the Indian Ocean and in the South Pacific where meteorological information is so slight that good synoptic charts cannot be drawn.

*This article is published with the approval of the Lords Commissioners of the Admiralty but the responsibility for any statement of fact or opinions expressed rests solely with the author.

New Port Opened in Chile.

A new port, named San Vicente, has been opened in Chile. It is situated in the southern part of the country, and is equipped with a new wharf and modern port facilities. The port has been developed to serve the Pacific Steel Company's plant near by, and is connected with the Gulf ports of the United States by the Gulf and South American Steamship Company.

Coast Protection

A Survey of Beach Stability

By R. R. MINIKIN.

(Continued from page 256)

Form of Protection

(8) Submerged Walls

In spite of the fact that the rise and fall of the tides complicate the mechanism of erosion and deposition, the coasts of tideless seas and lakes also have their share of troubles. The coasts of the tideless lakes of North America, at times, suffer heavy damage from northerly storms and ice effects. The Dead Sea also is not immune; whilst the ravages of the sea in the Mediterranean are historical. However, the differences of beach building and depletion in these areas are of degree, and not of principle.

The troubles experienced on the Michigan Lake front at Chicago are worth considering. Though there is a season variation of water level, the general or average level does not fluctuate a great deal, in fact, in Chicago, it is the official datum of all levels by the Lake shore, much as the Mean Tide level used to be in this country. The early methods of shore protection in Chicago was to drive double rows of timber piles and plank them to form two parallel walls. The space between was filled with quarry waste. The tops of these walls were built up with heavy rocks to about 4-ft. above water level, the jagged edges protruding. The walls were aligned with the shore line and placed some distance into the lake;

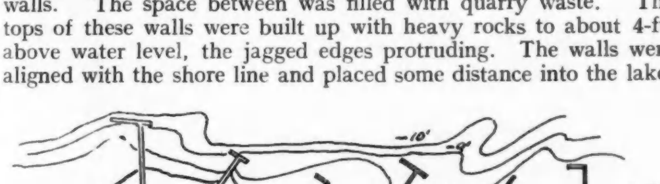


Fig. 62. Groynes on South shore Chicago now dismantled.

that is, enclosing a shallow area of water between the wall and the original shore line, which was later filled up with quarry waste. Unfortunately, these walls did not last long, they were subjected not only to storm damage, but to crushing and battering by ice.

This method gave way eventually to groyning, or in American parlance "shore jetties." They were aligned at various angles to the shore line with their roots in a sea-wall (revetment wall) sited on an adopted shore line as detailed above. One such system on the South shore at Chicago is shown in Fig. 62. It should be remarked that there is very little littoral drift on this coast. The groynes are all constructed of timber of heavy scantling. The curious features of the designed lay-out is the steep angle of inclination of the groynes to the wall, and the spurs at the seaward end. These spurs were added on the assumption that they would reduce eddy currents and cause deposition of sand. On what basis this assumption was founded is difficult to divine, for all experience shows they have a contrariwise effect. The mechanically suspended sand can only be caused to rest on the bottom by a reduction of velocity below the transporting current velocity. Spurs across a current do not do this, they merely change the direction and cause complex eddies. On the North side Chicago Lake frontage there were also groynes of the timber wall rock-fill type, but, instead of spurs at the extremities, they were placed about one-third of the length of the groyne from the seaward ends, and on the lee. The lines of these groynes were at about 70 degrees to the shore line, inclined towards the weather side, that is to the North, whereas on the above-mentioned South side groynes, the inclination was away from the North.

It is not surprising that these groynes proved ineffective for beach building. They were replaced in the first instance on the

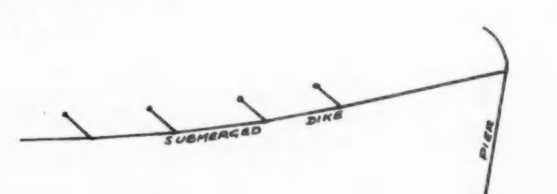


Fig. 63. Plan of submerged dike of sheet piling.

South shore by submerged dykes. These were constructed of mounds of tipped quarry run stone aligned 300 to 500-ft. seaward of the existing shore line and in an average depth of water of 20-ft. The cross-section of the mound was trapezoidal with top width of 12-ft., at 8-ft. below water level. The side slopes were 1 vertical to 1½ horizontal. The central core of quarry waste was covered with large selected stones of from 2 to 10 tons weight. These facing stones were laid on the slope with the long axis perdendicular to the line of the mound. At the two extremities of the dyke larger moles or mounds of tipped stone, with top 9-ft. above water level were built out from the shore thus enclosing an area of the lake bed, with the seaward side submerged. This area was partially filled up with quarry waste, and then blanketed with sand, to form an artificial beach for protection of the coast line and property and to provide amenities for the public.

The success of this scheme inspired the authorities to extend the submerged dyke system. On the Lincoln Park frontage severe erosion had taken place during winter storms. The spur groynes were badly damaged and became an eyesore on the beach. It was decided that a submerged barrier of sheet steel piling would be a satisfactory solution. Thus along the front in about 15-ft. of water a line of single steel sheeting was driven with the top edge of the wall at 4-ft. below water level. This wall (Figs. 63 and 64), is divided up into panels of 28 to 30-ft. by box piles having their heads 4-ft. above water level. These box piles, built up of the same sections as the sheeting, serve the purpose of markers and add strength. They were driven 4 to 8-ft. further into the bed than the panel sheeting. At about 10-ft. centres between the marker box piles there are other box piles of the same height as the sheeting, but driven 4-ft. further into the bed. These serve as stiffeners. After driving, all the box piles were filled with concrete. With the intention of reducing scour at the dyke face spur groynes of sheeting 75-ft. long were run out at 45 degrees to the line of dyke. The seaward extremities of the spurs end in 5-ft. diameter piers built up with sheet pile sections and then filled with concrete. The top of these piers are 8-ft. above water level and the tops of the spur wall sheeting are about 1-ft. below the water level.

A later extension of this dyke was built without spurs. To take their place, quarry run waste was tipped on the lake bed at the face of the dyke. The height of the panel sheeting was also modified to 3-ft. below water level instead of 4-ft. Under a frontal sea the submerged dyke will cause almost total dissipation of the orbital energy of waves over 4-ft. amplitude (Fig. 65). As the wave approaches the dyke and the water level in the trough (1) sinks to the head of the sheeting, the wave front will steepen (2) as though running into a shallow. The back flow of the water from the lee of the wall will augment this effect and the wave crest will further steepen and break (3) projecting its water into

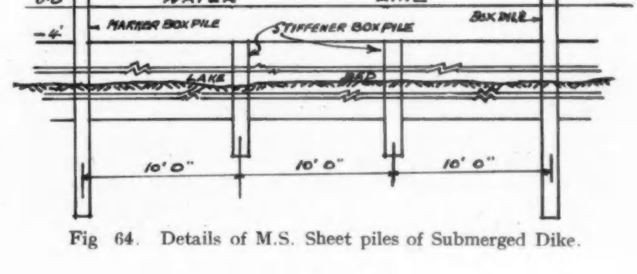


Fig 64. Details of M.S. Sheet piles of Submerged Dike.

Coast Protection—continued

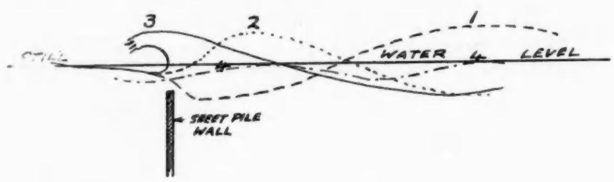
the lee of the wall. There will result a continuous see-saw, at the wall, of breaking waves and backward spill. This implies that some of the energy of the offing waves is expended on the wall, the remainder is expended in the energy of the projected water in reforming into waves of lesser amplitude some distance to the lee of the wall.

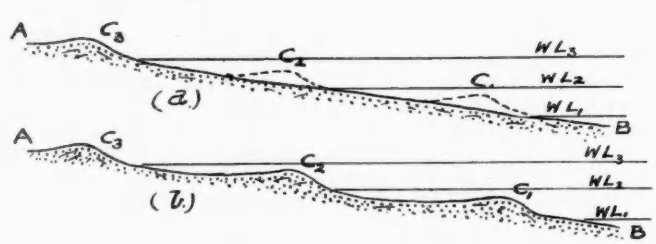
Therefore the wall must be made sufficiently strong to resist pressures arising from an assumed wave having energy equal to the difference in energy of the original wave and the reformed wave.

In Spain and Portugal submerged dykes of heavy tipped rock lumps are common practice for wave breaking. The distance from the shore line (H.W.) varies with the depth and exposure. They are commonly placed in 12-ft. of water.

(9) Groynes and Palisades

Groynes. The groyning of a beach is undertaken for the preservation or increase of the existing heights of the profile, and by reason of this, the protection of a sea wall. By and large, groynes by themselves, that is, without the aid of a sea wall, are not effective. The efficiency of a groyning system is affected by the amount of littoral drift, and the tidal range and currents. Since the effects of littoral drift and tidal currents have already been discussed it will be profitable to consider the effect of tidal fluctuations upon a natural beach.





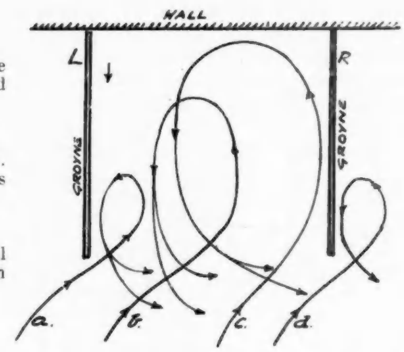


Fig. 65 (Top Left). Wave dissipation at Submerged Dike.

Fig. 66 (Bottom Left). Effect of tidal fluctuations upon a shingle beach.

Fig. 67 (Right). General particle movement between groynes.

Let A, B (Fig. 66), represent a tidal shingle beach lying originally at a uniform slope from A to B, with the still water level, at the beginning of the observations, at WL_1 (H.W.N.T.); assume that waves of sufficient amplitude break on the beach to build up a crest C_1 to be followed in the normal sequence by a higher level of tide WL_2 which forms a crest C_2 at the expense of C_1. A yet higher tide WL_3 (H.W.S.T.) follows to build the crest C_3 at the expense of C_2. Thus at the low tide of WL_3 there will be one crest C_3 left on the beach at the maximum reach of the surge, and the remainder, to low water level, will slope more or less uniformly seawards, excepting perhaps for a flattened step and shelf near the upper plunge line.

On the reverse action with a falling range of tides, at similar wave intensity, there will remain crests C_3, C_2 and C_1, as shown in full lines in Fig. 66 (b). If the wave intensity is decreased, as happens in fine weather, the beach building effect is weakened and the gentle surge is not sufficiently strong to lift the shingle to the top of the crests. Therefore any particles in movement not being able to mount perpendicularly up the steep slope of the crest take the easiest path and roll sideways. Now, since any crest formation is evidence of beach maturity at that point (under the given wave intensity), when the particle carried by the weak surge comes temporarily to rest, it is unstable, and the return flow, even though the beach is highly porous, will drag it down again to some position to the right or left of its original starting point, depending upon the sweep of the surge and the return flow. However, when the height of the water is such as to cover the crest C_1 the characteristic stability of the dry material is diminished, and even though the surge is extremely weak, the slope will be drawn down (flattened) as the particles urged forward beyond the crest will not return. Those particles dragged down the slope by the return flow will be shuffled into position to form the flat shelf characteristic of the middle beach. Thus, in calm weather, the beach building process though weakened in intensity still goes on to level out all the extra normal accumulations of heavy weather.

When in the weakened state, the tidal currents and wind effects become more pronounced. It has already been remarked that the wind has great influence on the currents in shallow water and when its direction (it need not be strong) coincides with the tidal flow, the gentle forward movement of the particles under the weak surge may be transformed into considerable longitudinal movement in the tide direction, in other words, the material rendered mobile by the weak surge, or return flow, is whisked along sideways by the wind and tide. Fig. 39 (p. 235, Jan.) shows the spread of passenger pebbles on the sandy beach in the foreground.

To achieve an efficient groyning system is usually a most difficult operation. The factors are most complex and vary to wide limits, in fact, on a beach of any considerable length it is almost certain that the conditions dominating one section are not the same as at another, and therefore, that which may prove effective at one part may be unsuitable elsewhere. Again the change wrought in the beach by the placing of one groyne may itself produce a different kind of change at a neighbouring groyne. It is therefore necessary to observe, and study carefully, the behaviour of any beach that it is proposed to deal with, not only from records of the changes of heights over a number of years, but daily, prior to definite settlement of the design and location. Even while works are in progress observation may show that modifications to the arrangement may be of advantage.

Now all factors of a beach regimen cannot always be noted, some change on the sea bed below low water level may have occurred, either on the direct frontage or on that of the near neighbouring coast. An example of this is the building up of a bank off-shore, such as that already described at Totland Bay, due to some chance incidence of Nature's vagaries. In the early stages of the building-up process, the neighbouring coast lines would be deprived of the habitual supply of make-up material, but the reason for this would not be in the knowledge of the engineer. It is only when such banks become more pronounced that we become aware of them. Within recent years the author had an interesting example of a very rapid change of this nature. This occurred in the Bay of Mount S. Michel, France where there are no man-made constructions. Near Cancale there was an unusual depletion of the beach. Within a few months the reason became obvious, a sand bank (in this bay, the mobile material is about 33% sand and 66% broken shell particles) was travelling into the bay. This moved forward very rapidly towards the coast of S. Benoit des Ondes. Measurements made by the author of this bank when it appeared above low water level are as follows: Length, tip to tip, 1,500-ft., maximum width, 320-ft., height at crest front 5-ft. above the natural beach to which it sloped down at the steep angle of 45 degrees, which is ample evidence of its high rate of travel. Similar cases of these travelling banks occur off the East Coast in Yorkshire and Lincoln. A

Coast Protection—continued

probable cause of these isolated migrating banks may arise from a rapid erosion of sand dunes during a storm and a heavily-saturated turbulence marshalling the particles into the deeper waters of the localized path of a strong set of tidal currents (see p. 235).

However, enough has been said to show that there may be a temporary depletion due to some hidden cause which may end even more suddenly, and develop into heavy accretion on the arrival of the gipsy bank inshore.

If, at low tide, observation is made of a groyned shingle beach that has been depleted, or is in the process of regeneration, but not mature, the contours of the shingle appear to show a definite pattern. It will also be noticed that the larger rounded pebbles are to be found along the boundaries of the groynes and the crest whereas at the centre of the area, where the contours are dished, the smaller pebbles are predominant. This is not exclusively so, for the grading is not so definite as to make it obvious, and besides, it is the looser surface particles which provide the evidence we are seeking. Let us assume that the waves out at sea approach the coast obliquely and that they are such as one might describe as a moderate sea, neither calm nor rough. As they approach the shore they will tend to become parallel, but that does not mean they will become parallel, in fact, according to Drs. Iribarren and Isla, who carried out many observations by aerial photography, the amount of wheeling on an open coast is not considerable, maybe 10 to 15 degrees.

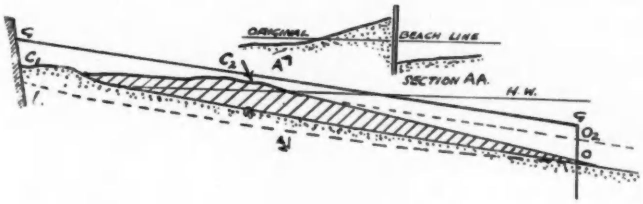


Fig. 69 (Above). Accretion at a groyne.

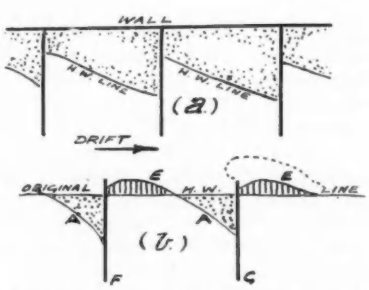


Fig. 70 (Right). Modification of high water line by groynes.

Then the plunge line of these waves on a beach where the assumed contours run parallel with the sea wall, and high water line, and more or less perpendicular to the groynes, will take place earlier at the groyne L than at the groyne R (Fig. 67), if the break occurs in the same depth of water. Then any mobile particles carried forward by the surge will tend to approach the groyne R. Now it is a matter of observation that the tendency of any particles carried along by a strong water current is to take every opportunity to escape from the impulse, that is, to escape from the stream to a position of rest. Thus the particle (a) will be deflected to the right before the effect of the break, which impels the particle (b), reaches it. The movement of the particles (b) and (c) will also be to the right so that eventually there will be a building up of the beach height alongside the groyne R; in other words, the contours of the beach are gradually changed between the groynes, and continuance of the process will eventually bring them more or less parallel to the wave front.

The result of this is that the surge now impels the particles forward up the new slope towards the corner between the wall and groyne R. In this process the slope of the beach is artificially steepened and a fresh phenomenon has been created. The press of the water, and the eddies set up at the extremity of the groyne L, cause an expansion of the wave, or surge, end after passing the tip of L, which weakens the effect of the surge at this point. At the same time there is a heaping up of the water on the groyne

Fig. 68. Weather side of groyne fully loaded. Groyne in the distance accreting in the corner only.

R, so that there is a dis-equilibrium in the surge forces from one side to the other which generates the effect of a circular flow. This action impels the particles along resultant paths in the manner shown by the arrows (Fig. 67).

It is not suggested that there is a current flowing in the circular path, it partakes more of an "inching" process developed by the forward surge pressure, the momentary eddies reflected from the weather groyne, and the two dimensional slope of the beach between the groynes. The particles moving over the beach under the surge impulse are, while still mobile, pushed away from the groyne by the reflected water, and then dragged down the slope by the return flow yet still further away from the groyne. Once the beach is conditioned to the contours arising from the continuance of this action, and no extra material enters between the groynes from the sea bed, there is an increase of the general two dimensional slope by the lowering of the original beach level alongside the lee groyne L.

Thus at any groyne the height of the beach on the weather side is greater than on the lee side as can be seen in Figs. 68 and 69. This brings into action another detrimental phenomenon: the break of a wave now occurs earlier on the higher levels of the weather side of the beach than on the lee (Fig. 68). The result of this is, on a porous beach, a hydrostatic head on the high material side of the groyne at the time the return flow takes place on the lee, or low, side, with the consequence that the beach on the low side develops a temporary quicksand effect. This facilitates the movement seawards of the particles and a shuffling of them towards the groyne R.

So far it has been assumed that the seas are oblique to the shore line and the beach has been moulded into a saw-toothed contour at the high water line (Fig. 70 (a)). If now the wave front changes parallel to the coast, the only change in beach building mechanism will be a reduction in intensity. However, should the obliquity be reversed and the original lee side of the

Fig. 71. Groyne of substantial construction.

Coast Protection—continued

Fig. 72. A Groyne doing efficient work

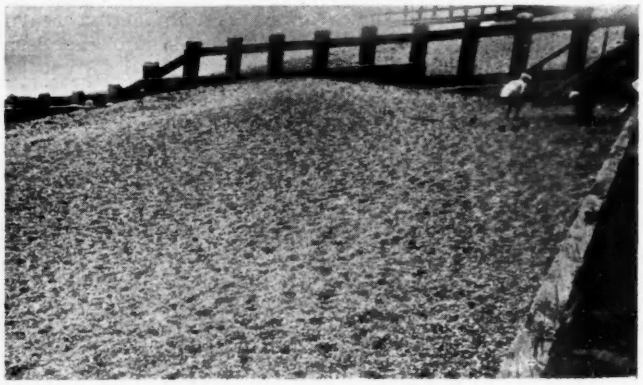


Fig. 73. An ideal result of well planned groynes.

groynes become the weather side, even though the flood tide and the littoral drift run contrariwise, then the movement of the particles within the confines of the groynes will be reversed. There will then be depletion where there was accretion, and accretion where there was depletion which, if continued, would swing the high water contour to face the new wave front.

It is obvious that this see-saw action is of no advantage and groynes to be effective and worth while should be designed to diminish the ill-effects of too much movement in the upper beach. In Fig. 71, it is to be noted that there is a considerable depletion of material exposing the sheeting at the toe of the wall. This groyne was erected in **1946**, and within a few months, there was an accretion of no less than 10-ft. of shingle to the weather side, while the lee side has remained more or less as illustrated. Note the uniform flat slope of the beach, a sure sign of denuding action. Compare this with the highly efficient groynes (Figs. 72 and 73) on the Leas beach at Folkestone where the beach level is the same on both sides of the groynes. These photographs show a fine beach crest built up to a width of 40-ft. from the sea wall. Compare, too, the weather side of groyne (Fig. 74). The slope of the beach and the markings on the timber show there has been a recent draw-down of the contours and no accretion. A point to note is the height of the groyne extremity. On the lee side of this groyne at the time of taking the photograph the surge tip was 70-ft. inshore of the surge shown in the illustration, that is, at the seventh king pile from the end.

Should a groyne have its upper extremity to the seaward of the high water line, it is found that only in very few favourable cases is there any accretion on the weather side, and even when this does happen, the material is most unstable. At the same time there is less depletion to the lee of the groyne, nevertheless there are instances of groynes erected by Mr. Case on the foreshore at Dymchurch acting efficiently. The upper extremities terminated at half tide level but by some fortunate combination of natural forces and the arrival of a well-charged littoral drift the beach was soon built up 5-ft. higher. Following this success, which incidently saved the damaged sea wall from undermining, the same engineer using the same methods at New Romney, further west, had no success until the groynes were extended to meet the sea wall.

Regarding the seaward extremity, it is a matter of observation that it is not good policy on a shingle beach to extend groynes over the sand line. The eddies set up by the groyne obstruction disturb the sand and hamper the free rolling movement of the shingle. Inspection of Figs. 39 and 40 show evidence of this. Compare these with the efficient behaviour of the short groynes of Figs. 36 and 38.

A most interesting feature, stumbled on by the author, on a shingle beach where the high water surge reached the sea wall, was the intense and insistent erosive action of the waters immediately to the lee side of a groyne in this zone. The remains of an old sea wall R (Fig. 76) lay close to the new wall and groyne. In the space B, between the two walls, which might have been expected to form a good trap for the shingle, it was found that the beach level was the same as that to the seaward of the old wall. To test the phenomenon some coal lumps were placed in the space B just before high water. When the tide receded, the coal lumps had disappeared without trace. On beaches where the groynes have their upper extremities landwards of the H.W. line and there is no sea wall, the tendency is for erosion to take place in the lee of the groynes as at E (Fig. 70 (b)), and deposition as at A. At the end groyne of a system at G the erosion is more pronounced and may develop as shown by the dotted line. If then the shore end of the groyne is not carried further inland it may even break through to the weather side of G and despoil the beach of the accretion at A. At Langley Point, Mr. C. H. Dobbie relates that to the north of the terminal groyne, which was 600-ft. long the high water line crept landwards about 200-ft. in 10 years. To counteract these tendencies of erosion to the lee it has been suggested to diminish the height and length of the end groyne, or to shorten the groynes uniformly landwards two or three degrees at the extremities. Results, so far, from these measures, have not been promising.

What appears to be an outstanding fault of most groynes is the

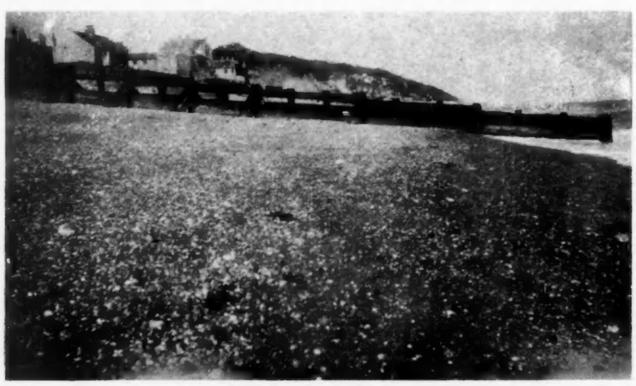


Fig. 74. A sturdy Groyne but not an efficient one.

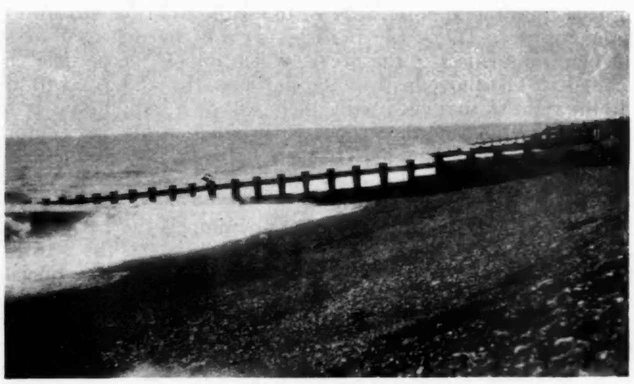


Fig. 75. A Groyne from the lee showing good height proportions.

Coast Protection—*continued*

unnecessary height. This tendency of late years has led to substantial but costly constructions, such as the detail of Figs. 71 and 77. This lavish use of timber does not appear to be an answer to the problem, as while some of them, in favourable natural supply, have successfully accreted shingle to a height of 10-ft. above the original beach at the time of construction, the beach to the lee of the groynes has not gained an inch. Later this highly unstable accretion was depleted leaving the beaches in little better summer condition than originally. To rectify this, some of the groynes were reduced in height by taking out the top strakes of planking. Indeed, on some portions of these beaches where recent work has been carried out the general level has been reduced about 4-ft.

If GG (Fig. 69) represents a groyne sloping at a, more or less, uniform height above the beach line C_1, O, and shingle is accreted against the groyne as shown by the hatched area, then the slope seawards from the new beach crest C_2 to O is steeper than the

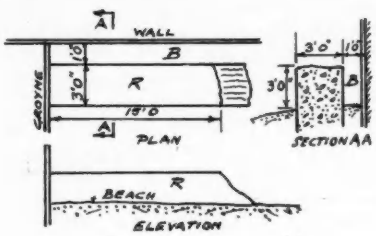


Fig. 76 (Top Left). Erosive action on the lee of groyne.

Fig. 77 (Right). Detail of Timber groyne.

Fig. 78 (Bottom Left). Suggested straking of groynes.

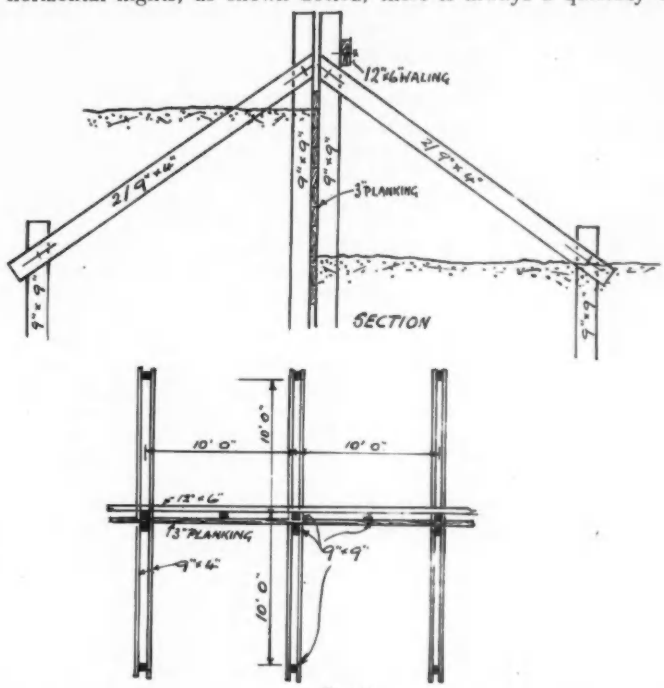
original stable beach slope C_1 O. Therefore to attain an equal stability the beach for the new crest should follow the thin dash line C_2, O_2. This is impossible so long as the beach level to the lee of the groyne remains at the thick dash line L, O. Until the beach to the lee, at the end of the groyne is filled up to O_2 there will be no increase of beach height at the end of the groyne. How then are we to fill up the lee?

We have seen that near the top of the low short groynes (Fig. 38), the shingle heaped up and spilled to the lee forming a mound there. This a step in the right direction. To do this on the groyne GG it would mean that the sea extremity should be reduced in height to encourage spill to the lee. It would be found that this would not be enough for the purpose, a further supply must be found. Here then we should look to the crest which is the most stable and mature part of the beach. If then the crests C_1, C_2 represent the maximum height of any possible accretion it will not be necessary to carry the groynes higher than this level. It has been seen that an efficient groyne (Fig. 72) is smothered by the shingle crest, then if the height were made so that spill into the lee occurred as soon as the crest width tended to increase seaward, the lee would be built up.

If this assumption is reasonable then the line of the top of the groyne should also be the outline of the profile of the beach desired. Then, once maturity was reached, all surplus would spill from the weather side to the lee, thus counteracting the tendency to erosion. Moreover, the behaviour of the particle movement within the confines of the groynes would now be radically changed from that of Fig. 67. The groyne, not being proud of the beach (accreted), will not now deflect the surge to the lee of its own compartment but will sweep straight ahead, and a frontal beach building process will be initiated. What this amounts to is, that a groyne should interfere as little as possible with the shore currents once the beach is built up to a possible and satisfactory profile. To effect this, from the beginning of a groyning system, one must guard against a too optimistic appraisal of the supply of material, and should carry out the work in reasonable steps. The heights and lengths of the groynes should be adjusted to the changes observed during construction and operations planned accordingly.

The current tendency of constructing groynes of heavy scantling to the full final height of proposed beach regeneration militates against any long term success. Another factor that emerges from the common practice of variation in height of the groynes is that the horizontal stepped strakes of planking and walings cause serious eddies in the water about the groyne. These eddies influence the approach of the particles on the sea bed, tending to deflect a portion seawards or along shore.

Abrupt changes in the height of a groyne should be avoided. The top edge should be as near as possible to the probable mature profile aimed at. To this end it is suggested that if the strakes of planking of the groynes were laid as shown diagrammatically in Fig. 78, not only economy of timber would ensue, but the groynes would act more efficiently as all the timber would be doing its part in beach building to the point of maturity. With the usual nearly horizontal flights, as shown dotted, there is always a quantity of



timber projecting above any probable beach height which can only cause detrimental eddies. Walings need not be at the tops, they may be placed in the suggested method coincident with the horizontal portions, or sloping within the line of the sheeting. The horizontal breaks in the line are proposed as spillways to the lee. Adverting to the construction of a new system of groynes, it is further suggested that the planking should not be extended over the beach for the full proposed length until some shorter length has developed a build-up.

(To be continued)

Publications Received

"South Wales Ports," the first book relating to the South Wales Docks Group of the Docks and Inland Waterways Executive, Cardiff, to be published since the war, takes the place of the pre-war "G.W.R. Docks." The handbook contains photographs and port plans and extensive information and will be issued gratis to persons interested in trade through the South Wales ports. The foreword states that if the country is to achieve victory in its rehabilitation aims the South Wales ports must be called upon to carry an appreciable share of the increased tonnage involved, both in imports and exports.

Particulars of holidays affecting shipping in the principal ports of the world are given in **"The Conference Holiday Calendar, 1949,"** published by the Baltic and International Maritime Conference, 35, Amaliegade, Copenhagen, price 3s., including postage. The Calendar lists general and local holidays.

Theft and Pilferage at Ports

Solution still a Major Problem

The Committee of the Liverpool Underwriters' Association, in their Annual Report for 1948, which was submitted to the Annual General Meeting on 31st January last, record that there has been little, if any, diminution of world-wide losses resulting from theft and pilferage of cargoes.

Commenting on this subject, the Committee say that claims are increased by long delays at ports of destination, due to currency difficulties, the non-arrival of documents and deferment of surveys. The poor quality of packing now used facilitates pilferage, especially during such delays. The Committee consider that the present situation fully warrants the continuation of the surcharge system, and discussions with underwriters of foreign countries, during the Conference of the International Union of Marine Insurance, showed clearly that the majority hold this view.

In further reference to the matter, the Committee state: "The theft and pilferage of cargoes imported into, and exported from, the country has continued during the year and remains one of the major problems confronting underwriters. A committee has been formed by the International Union of Marine Insurance, which collates information received from all members of the Union, and, while it is true to say that in most countries there has been some improvement in the position, there is no doubt that, generally speaking, claims for theft and pilfering continue to have a seriously adverse effect on cargo accounts. The Committee have ascertained that the aggregate theft, pilferage and non-delivery figure for all cargo claims paid in 1947, on account of all underwriting years, represented approximately 28.18 per cent. of total gross cargo claims, inclusive of total losses. This figure alone indicates to some extent the serious drag which the evil exercises upon the country's export drive, quite apart from the reduction in the quantity of imported goods reaching their legitimate market.

"On Merseyside the repair of war damage to sheds and warehouses is still curtailed by a lack of adequate supplies of material, and many of these buildings are, consequently, not secure against unauthorised entry. It has been stated that building licences up to a value of £600,000 have been authorised for the repair of privately owned warehouses on Merseyside during 1949, and it is hoped that when the authorities review the programme for repairs to be carried out in 1950 it will be found possible to increase this figure substantially. The police forces of Birkenhead and Liverpool continue to make every endeavour to deal with the situation in spite of a lack of adequate numbers on their strength. In Birkenhead the number of constables and detectives on the docks has been slightly increased, especially during periods when thefts are likely to occur, and the number of observed crimes have shown a heartening decrease, while in Liverpool the introduction of mobile squads on the Dock Estate has proved effective.

Parks for Loaded Lorries

"Endeavours are now being made to arrange for lorries with valuable loads, either for export or import, to be parked in reserved compounds in the City instead of being left unattended overnight when drivers are unable to proceed either into the docks or to their destinations. There are several sites cleared of bomb debris, the location of which would appear to be ideal for this purpose. The Committee would strongly support a scheme for the intrduction of such compounds on selected sites all over the country, as there is no doubt that a great number of thefts take place whilst goods are in transit on land.

"In an effort to minimise the diversion into illegal markets of goods intended for export, the Committee have suggested that careful consideration should be given to the possibility of the introduction of a scheme for the indelible stamping of such goods at the factory. In the case of textiles, for instance, it is understood that, from a manufacturere's point of view, it would be feasible and inexpensive to weave into the selvedge of cloth intended for export a distinguishing mark. A small identification mark could be imprinted on other goods wherever possible. The new practice of stamping goods intended for export and the distinguishing marks to be used could be widely publicised. Whilst it is realised that such a system may not be possible in the case of some goods manufactured for foreign markets, it is thought that some such procedure might well be adopted in very many cases and, whilst serving as a deterrent to the dishonest, would enable the honest citizen to detect and report illegal sales, quite apart from the assistance which would be afforded to the police during investigations of suspected cases of stolen goods.

"It has been noted with interest that the Chamber of Shipping of the United Kingdom has set up a co-ordinating committee to advise Government departments and organisations inquiring into the problem. The Committee will continue to give any help which is within their power to committees set up by the Chambers of Commerce of London and Liverpool to deal with the problem, and strongly support the suggestion made to the Institute of Packaging that the system of a standard package code should be introduced in order to encourage the better and more intelligent packing of goods, which would undoubtedly contribute very largely to a reduction in losses. Although the Committee feel that much can still be done to alleviate the evil, they consider that claims resulting therefrom will remain high until such time as consumer and luxury goods cease to be in short supply."

Operational Aspects of Marine Radar

Symposium of Papers read before the Institute of Navigation

On 18th February last a meeting of the Institute of Navigation was held at the Royal Geographical Society under the Chairmanship of Sir Robert Watson-Watt, C.B., F.R.S., a Vice-President of the Institute. During the convention, twelve papers covering different aspects of the use of marine navigational radar were read by representatives of the radio industry, shipping companies and various units concerned with operational research.

In his opening remarks, the Chairman pointed out that radar as an aid to navigation was comparatively new to the Merchant Navy with a history of only three or four years. It was a subject on which no operational text books had been written, and where to a great extent, techniques were being evolved by the users as their experience grew. It was the object of this symposium to help all those directly concerned with marine radar by describing as fully as possible the experience gained to date, and allowing a free discussion in which the different, and sometimes opposing, points of view could be put forward. It was hoped that many of the points brought up at the meeting would help to define the position as it was to-day, and so be of immediate help to both users and manufacturers in indicating the possible trends of development.

The first paper, **Experience in fitting radar to vessels of different types and sizes,** by Colonel B. S. Millard, technical adviser to Coast Lines, Ltd., described some of the difficulties in siting the equipment to give the best results and at the same time to conform to other requirements of ship-fitting. His Company had fitted some 24 vessels varying in size from 700 to 4,000 tons, and his own conclusions as a result of this experience were that new vessels should be planned to accommodate the instruments it would carry, especially radar equipment. Where the length of the wheelhouse superstructure was small, and a tower of above average height was necessary to put the radar at a safe distance from the compass, he suggested the use of telescopic or hinged tower; especially in the case of coasters and colliers unloaded by shore cranes using a grab; this would reduce the risk of damage.

Funnel masking of the radar could sometimes be overcome by placing the scanner on a foremast abaft the wheelhouse; the objection to putting it on a foremast placed forward, is that in most ships, the vibration on this mast is too heavy. A high tower to clear the funnel does not allow the minimum range necessary for negotiating narrow buoyed channels. In ships with bow-rudders the difficulty of siting the scanner has sometimes been overcome by fitting a second scanner abaft the funnel.

Operational Aspects of Marine Radar—continued

Where it is necessary to fit the scanner on one side of the fore-and-aft line of the vessel, Colonel Millard advocated the starboard side so that a clear view of a vessel crossing from that side (which has the right of way) could be obtained.

B. R. Davies and L. W. Brown (B.T.H., Ltd.), read a paper on **The translation of operational requirements into a practical marine radar,** in which they dealt with the siting of the various controls and with the problems of maintenance. On the question of presentation, they advocated a single range circle of variable diameter, rather than a number of circles of fixed diameter, as the former allowed more accurate bearings to be taken.

An analysis of operational experience gained in the fitting and use of navigational radar was made by H. R. Whitfield, A. Harrison and T. Pope, of Kelvin Hughes, Ltd. Some of the problems mentioned in the first paper were here considered from the manufacturer's angle, and some suggestions were put forward as to how the difficulties could be overcome. It was stated that experiments were being carried out with refracting prisms which have the effect of bending and broadening the radar beam, and so illuminating the area behind obstructions such as masts and samson posts.

Tables of performance figures obtained in both British and foreign ships were presented, and these summarised very fully the standard to be expected from a modern ship-borne equipment. The effect of weather on the standard of performance was also analysed and figures for the range of detection of icebergs were given. It was found on a number of occasions that icebergs rising to some 20-ft. could be seen at 3 miles, but remained undetected by radar. A full examination of the behaviour of radar with targets of ice was advocated.

Some experience of marine radar was described by Mr. O. Puckle (E.M.I., Ltd.), who described data collected on trips made by ss. *Seemew*, Flagship of the General Steam Navigation Company. The conclusion was drawn that a ship could be navigated in any visibility by radar alone as far up the Thames as Southend Pier, and in certain conditions as far as Lower Hope or Middle Blythe.

The question of eye-strain watching the double screen sulphide tube may be overcome as a result of work now being carried out on the poduction of fluoride tubes which are less tiring to watch. Further reduction of eye strain can also be achieved by reducing the speed of aerial rotation. The use of the range marker ring to keep a minimum distance from rounding a point advocated especially when turning to enter a narrow entrance.

Two papers presented by the United States Institute of Navigation were read. Captain A. H. Andrews (United States Lines), whose paper was read in his absence, described the experience gained by 53 ships of his Company which had been fitted with 10 cm. equipment. An interesting point was that the instructions given to the masters of radar fitted vessels by the Company's Marine Superintendent made clear that, for the present, the equipment is to be regarded solely as a collision warning device.

The second American paper was contributed by E. C. Isbister and W. Griswold, of the Sperry Gyroscope Company, Inc., under the title: **Some American views on the operational characteristics of marine radar.** This included a description of the use of radar by tug masters on the Mississippi, where barges are "shoved" into comparatively small lock gates in all weathers.

A. L. P. Milwright (Royal Naval Scientific Service) presented a paper on **The desirability of increasing the radar echoing characteristics of buoys and small boats.** In this he described measurements that had been taken to determine the strength of echo received from navigational buoys and small boats. The measurements showed that in a rough sea no amount of swept-gain would make a second class buoy or a 60-ft. motor fishing vessel visible on the screen at ranges between ½ and 1¾ miles. The conclusion was drawn that buoys and small boats should be fitted with corner reflectors in areas where rough seas are likely to be encountered.

In **Charts and chart matching devices,** by Lieutenant-Commander P. G. Satow, D.S.C., R.N., the chart comparison unit was discussed as a method of identifying targets on the P.P.I Modifications (which are under consideration by the Admiralty) to Admiralty charts to make them more suitable for use with navigational radar were also described. These include modifications to the charted topography to assist in the identification of landfalls, and added prominence to the coastline.

E. Parker & L. S. Le Page (Operational Research Group, Ministry of Transport) in **Operational factors and Operational yields** cited some of the operational problems over which shipowners, manufacturers and Masters exercised some control. The saving of worry to ship's officers, the saving of casualties, and the saving of time were put forward as the principle benefits of radar assisted navigation.

It was estimated that 45 U.K. ships in 1947 and 40 U.K. ships in 1948 were involved in collisions which might have been averted had they been fitted with radar, and that in the two years, 50 and 45 strandings of British ships might also have been averted had radar been fitted. Of British vessels fitted with radar, one was involved in collision in 1947, and seven in 1948. In only one of these cases did it appear that the ship was carrying out a manœuvre unlikely to have been attempted without radar.

Examples of the use of radar in effecting rescue operations were given, including that of the Norwegian "Veni" whose crew were all saved by *Weather Recorder* in an operation (January, 1948, off Islay) carried out almost entirely by radar.

The saving of time by the use of radar was effected by enabling an increased safe speed to be maintained, minimising departure from the scheduled course, reducing clearance when rounding navigational hazards, enabling the Pilot Cutter to be located quickly, and assisting ships in entering and leaving harbour. It was estimated that an increase in earning power of some £2 million a year could be achieved if the entire British Merchant Fleet were fitted with radar.

During the four-day fog (November 27th to December 1st, 1948), in London, 120 inward-bound ships were seen to be at anchor at one period. The probable cost of the delay to these ships was estimated at about £17,000 per day from running costs alone; these costs are only a fraction of the total economic loss through time lost by outward bound ships, etc. It was estimated that the time lost through a four-day fog was equal to that by 16 fogs of one day's duration each, because the number of ships involved, and the delay, are proportional to the fog's duration. The number of British Merchant ships fitted with radar was given as 429, and this included 45 per cent. of all passenger liners and 44 per cent. of all passenger-cargo liners. The rate of fitting ships with radar during the summer quarter of 1948 was given as one per day.

Considerations on the use of ship-borne radar, by Captain E. Wylie, R.N., ret. (Radio Advisory Service to the Chamber of Shipping and Liverpool Steamship Owners' Association) surveyed a wide field of present-day problems of marine radar.

The advantages of the chart comparison unit were discussed and the conclusion drawn that they could be more economically gained by other methods. In particular the use of P.P.I. photographs was advocated as a method of land echo identification which leaves the chart free for other uses.

Methods of plotting were also discussed and the "Spider's Web" form of relative plot was put forward as the most straightforward and accurate. The advantages of true and relative displays were also reviewed, and the question of controls for the set was considered from the point of view of operators working under different conditions.

As a method of ensuring that most defects can be remedied at sea, it was suggested that more adequate testing facilities, and possibly valve monitoring facilities should be provided.

The ultimate requirements of ship-borne radar were considered in the light of the mariner's normal perception which is conditioned by his experience of visual navigation. It was put forward that present-day P.P.I. navigation does not call into play the many senses by means of which the mariner normally appreciates a situation and that a considerable enlargement of the display might give an added confidence, particularly when avoiding collision, or navigating in confined waters.

Shore-based radar as an aid to the operation of ferries, by L. D. Price, the General Manager of Wallasey Ferries, described some 17 months' experience gained in using a ship-borne radar installed

Operational Aspects of Marine Radar—continued

ashore for operating ferries in thick weather. The ferry between Wallasey and Liverpool carries twenty million passengers annually and the installation of shore radar has enabled the service to be continued in all weathers. As an example of the service maintained in thick weather, a period of nine days in which the visibility was almost continuously down to 50-ft. was cited; in this period 845 of the 861 sailings scheduled were made.

Work on a specially designed installation is at present being carried out; in this the indicator console will utilise two 15-in. tubes and the display ranges will be 0.8, 1.6 and 4.8 miles on both. Amongst other advantages this will enable operators ashore to advise the ferry Masters at the oiling jetty which is at the moment on the extreme range of the existing set.

The use of Harbour Supervision Radar was described by Commander W. Colbeck, Marine Surveyor to the Mersey Docks and Harbour Board. The installation described was that at Gladstone Dock, Liverpool, the first Harbour Supervision Radar in the world; it was officially opened in June, 1948. The display console houses six display units, four of which give a large scale plan of parts of the channel, the fifth a small scale plan of the whole of Liverpool Bay, and the sixth can be switched to cover any part of the Bay on the large scale. Vessels entering the port communicate with the Port Radar Station (whether they want radar information or not) giving their draft and expected time of arrival. Information derived from the displays is communicated to the Port Authority's Office by teleprinter and telephone, and to the Masters and Pilots by radio telephone. Positional information is given to the ship by one of four methods, a bearing and distance from the station; by reference to a grid; by bearing and distance from the nearest known object; relative to the centre line of the channel, or the line of buoys.

Amongst its other uses the installation can maintain a control of traffic in the approaches, and check the position of navigational buoys and of ships at anchor. It is operated in clear weather at four-hourly intervals and at 4½ hours to High Water. In thick weather the equipment is operated continuously except for a two-hour break at the day Low Water period.

Examples of how the equipment had been used in the prolonged foggy period in November were given and the figures showing the number of ships entering and leaving the port in September, October and November showed that there had been no reduction.

R. F. Hansford, Technical Secretary of the Institute, speaking on **The present outlook,** stated that the progress made in the last year or so was highly satisfactory, but that much remained to be done in the way of developing new equipment; in particular the problem of blind pilotage for the big liner remained to be solved. There was still a need for a fuller interchange of information between the mariner and the radio engineer so that progress and development could be spurred on. He felt that the Institute could make a material contribution to practical advancement in this sphere and that the unrivalled experience of British seamen combined with the traditional soundness of British engineering put this country in the forefront in showing the way in which radar navigation should develop.

Correspondence

To the Editor of *The Dock and Harbour Authority*.

Dear Sir,

African Transport

Having had considerable experience of African ports, waterways, roads and railways, may I, through your courtesy, invite your readers to support my urge that the transport problems of Africa should be considered on a Pan-African basis before any further costly ventures are finally approved, particularly in East Africa?

From a transportation point of view, in peace, and still more in war, the hasty inauguration of the East African ground nut scheme in a remote Tanganyikan locality was a monumental mistake. It has congested the port of Dar Es Salaam and has involved the construction of a new port on the distant and vulnerable East coast. The allocation of priority contracts to this new port construction has delayed the development of the ports of Dar Es Salaam, Tanga and Mombasa in particular, in addition to that of other African ports. The scheme has failed to produce much tonnage of ground nuts for U.K. consumption at a time when there are already stock piles amounting to nearly half a million tons held up in Nigeria for want of transportation capacity to clear them. In short, any such new scheme for production should have been located on a main transport artery, either existing or definitely projected, and, for choice, leading to the nearer and safer West Coast of Africa.

The debate in the House of Commons on 25th January last shows clearly that planning for further lengthy railway construction in East Africa is reaching an advanced stage, whilst international planning on a Pan-African basis is still only a pious hope.

An extension of the Tanganyikan "pea nut" line further inland is contemplated, so as to develop a new coal area in particular, at a time when lack of transportation capacity alone debars the export of the coal from the existing mines in Southern Rhodesia, which are ideal for economic working.

A rail link is planned between the Tanganyikan central line and the Kenya southern line with an alleged advantage that this would enable some Tanganyikan products to be diverted for export via Tanga instead of via Dar Es Salaam; this at a time when the maximum expansion of Mombasa and Tanga ports is required to cope with output from new industries in Uganda and Kenya and to meet naval base and other military needs.

In the same debate the recent important decision at last to improve to highway standard the track (the so-called Great North Road) from railhead Broken Hill in N. Rhodesia to Nairobi and Mombasa is given little prominence, and the question of a new British line from Southern Rhodesia to Walvis Bay, to carry vital coal and steel to a British port on the safer and nearer West Coast, instead of to Portuguese Beira on the East Coast, is airily dismissed by the Colonial Office spokesman as being a matter for another Government Department. In fact, those who know East Africa may well suspect that the local railway enthusiasts are again being allowed to press on with their pet local schemes to the detriment of African development as a whole and at the expense of road improvement and extension in particular. All this is going on at a time when it is impossible for a traveller to drive a car in moderate safety and certainty across Africa from north to south or east to west.

Pan-African planning must be instituted to decide the following:

(a) Priority of allotment of equipment for increasing the capacities and facilities of all existing ports, waterways, railways and roads to meet the maximum expansion of existing industrial projects;

(b) The trans-continental highways to be constructed, having due regard to the development of further sources of minerals, foodstuffs, etc., to the opening up of backward territories and to the joint strategical requirements of the Western nations and the Arab League;

(c) The extent to which highways should, in the first instance, be roads which are more generally useful, more flexible, less vulnerable and less costly rather than railways, which are so rigid, vulnerable and costly, as well as absorbing so much more of the equipment of all natures which is in short supply.

More co-ordination of British governmental machinery is obviously essential if this comprehensive planning is to be achieved. In regard to Africa at least the policy of regionalisation should be adopted now. An African Relations Office in London should take over African affairs from the Colonial Office, Commonwealth Relations Office, Foreign Office, Food Ministry, etc. This new Office should be advised by Pan-African conferences in Africa. Ultimate planning should be international and American support of it assured in pursuit of the policy outlined by Mr. Truman in his inauguration speech.

Yours faithfully,

G. S. BRUNSKILL.

Elm Lodge. Old Scriven,
Knaresborough, Yorkshire.

The Winding of Rivers

A Water Engineering Problem

By ERIC HARDY, F.Z.S.

It is a popular notion that the flow of a bending river is most rapid on the outer side, where its banks are concave, and the well-known scouring or excavating action exerted by a stream on this bank is attributed to this imaginary flow. Professor Watts mentions it as such in his textbook on geology, so does the French geological writer, Le Conte, in his compend of geology; but as the late Sir Oliver Lodge and Professor James Thomson disclosed, the fact is that under many circumstances the flow is most rapid on the inner or sediment depositing side of the bend, and the excavating action of a river is not due to the direct scouring action of the main stream at all.

The rapid flow on the inner and strongly curved side of the bend piles up the water on the outer side by centrifugal force, so that near the concave bank it is nearly stationary, but elevated; its energy there is potential, not kinetic. Owing to the retardation of the bed, the flow near the bottom is slower and not nearly so much centrifugal force is exerted there. The piled up water is continuously returning from upper to lower level, or from the concave to the convex bank, as an undercurrent almost at right angles to the main stream, bringing the silt and solid erosion to deposit on the inner side of the bend and thus continuing its own sinuosity. It is a very interesting and important problem for water engineers faced with the control of meandering rivers on plains, where the stream progresses with a lateral circulating motion which screws itself like a corkscrew round a bend. The lateral circulation moves the bed, and the flow is most rapid on the inside of the bend. It might even be stationary or retrograding on the outside bend.

In the dry season, when the water is low and the channel is larger than the flow, the flow is perceptibly faster over the shallow inner side of the bend than in the deep channel on the outer, and the line of maximum velocity is nearer the inside than outside of the bend. But at floods, a day's erosion may be more than that of a decade or a century of placid flow—it sweeps rapidly round the outside of the curve while the inner side remains rather slack. The line of maximum velocity then becomes more sinuous than the river itself, and there is an upward rather than a downward current along the bed on the outer side of the bend.

In one instance the flow was measured at the surface of a bend of the River Wey at Godalming. At 3/10ths the distance from the inner bank the flow was 0.30 feet per second; at half the distance it was 0.45; at 3/5ths the velocity was 0.55 feet; and at 4/5ths as fast as 0.71 feet; but close to the outer bank, back eddies formed a set of feeble whirlpools, e.g.:—

Distance from Inner Bank.	Velocity, ft. per sec.
0.3 of distance	0.30
0.5 ,, ,,	0.45
0.6 ,, ,,	0.55
0.8 ,, ,,	0.71

At a meeting of the British Association, Buchanan showed the influence of meandering upon river length by the following tables:—

River on Stretch		*Length of Stretch*		*Ratio*	*No. of Bows*	*Average length of Bows*
(1) MISSISSIPPI		Direct	Along Windings			
From	*To*	Miles				Miles
Columbus	Memphis	124	204	1.65	23	8.87
Memphis	Natchez	270	490	1.83	62	8.10
Natchez	Baton Rouge	88	133	1.51	18	7.39
Baton Rouge	Carrolton	72	124	1.72	20	6.20
Columbus	Carrolton	554	955	1.72	122	7.83
(2) THAMES						
From	*To*					
Marlow	Walton	18.7	30.0	1.61		
Teddington	Isle of Dogs	16.8	26.5	1.58	11	2.4
(3) DANUBE	Near Mouth	11.4	22.5	1.97	13	1.73
(4) RHINE						
From	*To*					
Gemmersheim	Mannheim	21.1	43.0	2.03	11	3.91

Thus for about a thousand miles the Mississippi is made to flow 1.72 times its direct distance because of windings; the lower Danube and Rhine are made to flow about twice their distance. It is the flood waters which form the bed, and the volume of river controls the size of the bows or bends. Water displaced to one side of the river will, in returning to it, tend to pass to the other side and to oscillate about the lowest point.

Now if engineers straighten the river course in loose alluvial land, so that the water flows along a straight trough cut in the material, it preserves a straight course for a time, but the stream is still in a state of unstable equilibrium and the smallest accident to the bank, or obstruction in the river, induces oscillations longitudinal and transverse which cut into the banks, taking larger and larger dimensions if these yield, and cease only when they have produced a sinuosity corresponding to the laws of harmonic motion of its waters.

The rhythmic motion set up in the mass of water becomes mainly two reciprocating motions, one in the direction of the fall of the stream and the other at right angles to it. In a very steep gradient the longitudinal oscillation is swamped by the powerful pull of gravity, which does not affect the transverse component. A small stream may thus describe an almost perfect harmonic curve. In the Mississippi there is but a very small gradient of 2-in. to 4-in. per mile and the longitudinal impulse produces its full effect. The two oscillations have simple pendulum motions and in the same period produce an ellipse, combined with the heavy onward flow due to gravity, to form sinuosities. If the period of transverse oscillation is twice that of longitudinal ones, it produces a figure of eight, but with a steady forward motion this becomes a gradual curve, pushed out into three parts, each a double bow.

If some dye like magenta is placed at the turnpool or outer bend of a river or small stream, it will be seen that an aureole of colour gradually develops there and then creeps slowly towards the inner bend of the stream. For measuring surface flow, mahogany sawdust is useful, as it approaches water in density and is not large enough to be influenced by air currents. In a stream the surface layers shear over the lower; the mid-stream portion shears through the lateral parts, and, in a meandering course, momentum impels the water towards the outer bend and shears it round the slower moving water in the inner bend. Many variable conditions, however, interfere with the normal flow of a river and these must always be taken into account. The cutting and wearing away of banks of rivers is mainly the result of eddies formed by the flowing water meeting with stones, trees, inequalities in the bank and other obstructions, or even water impinging upon water, as the eddies where waterfall water meets with the quieter water of pools. The practice of protecting banks by throwing the water off them into the middle of bed by means of "tooks," or little piers, usually fails because the piers cause eddies, scoring deep pools which endanger the banks, and the piers tend to throw the water to the other side of the channel; but the sloping bed throws it back again, to strike the bank below the pier. The problem was overcome in the River Adda, from Lake Como, Italy, by smoothing out the irregularities and simply paving it with small cobble stones a few inches in diameter, over which the water flows without eddies, providing there is no break.

The detritus carrying power of a stream varies as the sixth power of its velocity (Rideout, "River Systems," p. 33; Robinson, "Discovery," 1939, p. 492), while velocity of course is affected by the steepness of the channel and the volume of water. Thus a stream flowing at 3 m.p.h. has more than ten times its erosive power as when flowing at 2 m.p.h. In a cross-section diagram of river channel, the friction is in proportion to the length of outline of contact of the stream for equal sectional areas of channel, modified, of course, by the slope of bed and the composition of the soil. The least amount of friction contact is in a semi-circular stream bed, the next least in one that is twice as broad as it is deep. A stream tends towards making the former bed by eroding the sides.

Amsterdam-Rhine Canal.

The Amsterdam-Rhine Canal is expected to be opened for 2,000 ton ships at the beginning of 1951.

Hydrography from the Air

We are indebted to Captain E. C. Shankland, R.N.R., late of the Port of London Authority and now a Hydrographic Surveyor and Assessor, for the accompanying aerial photographs of Boulogne Harbour and for the following remarks from a letter of his upon the subject of such photography applied to marine survey work.

Captain Shankland points out that many sea birds have always practised the art of rising to considerable heights in the air in their endeavours to locate below the surface of the water the fish upon which they feed. It is only recently, however, that the aeroplane and the photographic art have been applied to aerial spotting of submarine craft and similar purposes.

The great improvements made by the British A.P.I.S. which so advanced the art between the two wars that, before " D " Day of World War II, the beaches of Arromanches became an open book of aerial photographs, and moreover our American allies in the Pacific utilised photographic detection to locate under-water reefs and obstructions at the many task force points covering the coral atolls held by the Japanese. They found to their cost that this preliminary was desperately essential in preparation for landing attacks.

One can therefore envisage the increasing utility of the application of aerial photography to hydrography, and the accompanying photographs, reproduced by consent of the Air Ministry, demonstrate several important features in harbour surveying.

In the first photograph there is the identification of a shoal and its particular formation near the mouth of the harbour. The situation of the cone where the least depth of water lies is evident, with the influence of the tide in the creation of this shoal clearly apparent.

By consulting tide tables and using the time at which the photograph was taken, it becomes possible to gauge the probable manœuvring space for a vessel entering or leaving the harbour at certain states of the tide—an important factor in the plans for recapturing the harbour and port.

In considering the conditions which go with the depth at which photographs can be secured, the first requirement is clear water —muddy conditions will defeat any endeavour to secure a picture of objects below the surface. The second is the absence of turbulence in the area under observation; while the third, which varies in different latitudes, is the active property of the sun's rays, together with the clearness of the sky—that is to say, freedom from clouds which might cast shadows, or excessive mist or fog.

In the Edinburgh Channel of the Thames Estuary, the sand formations of the bottom (42 feet deep) can be seen on a calm day with the naked eye from the deck of a small vessel, but the camera is more definite at an elevation as it provides a more comprehensive picture of the area and establishes a pictorial record.

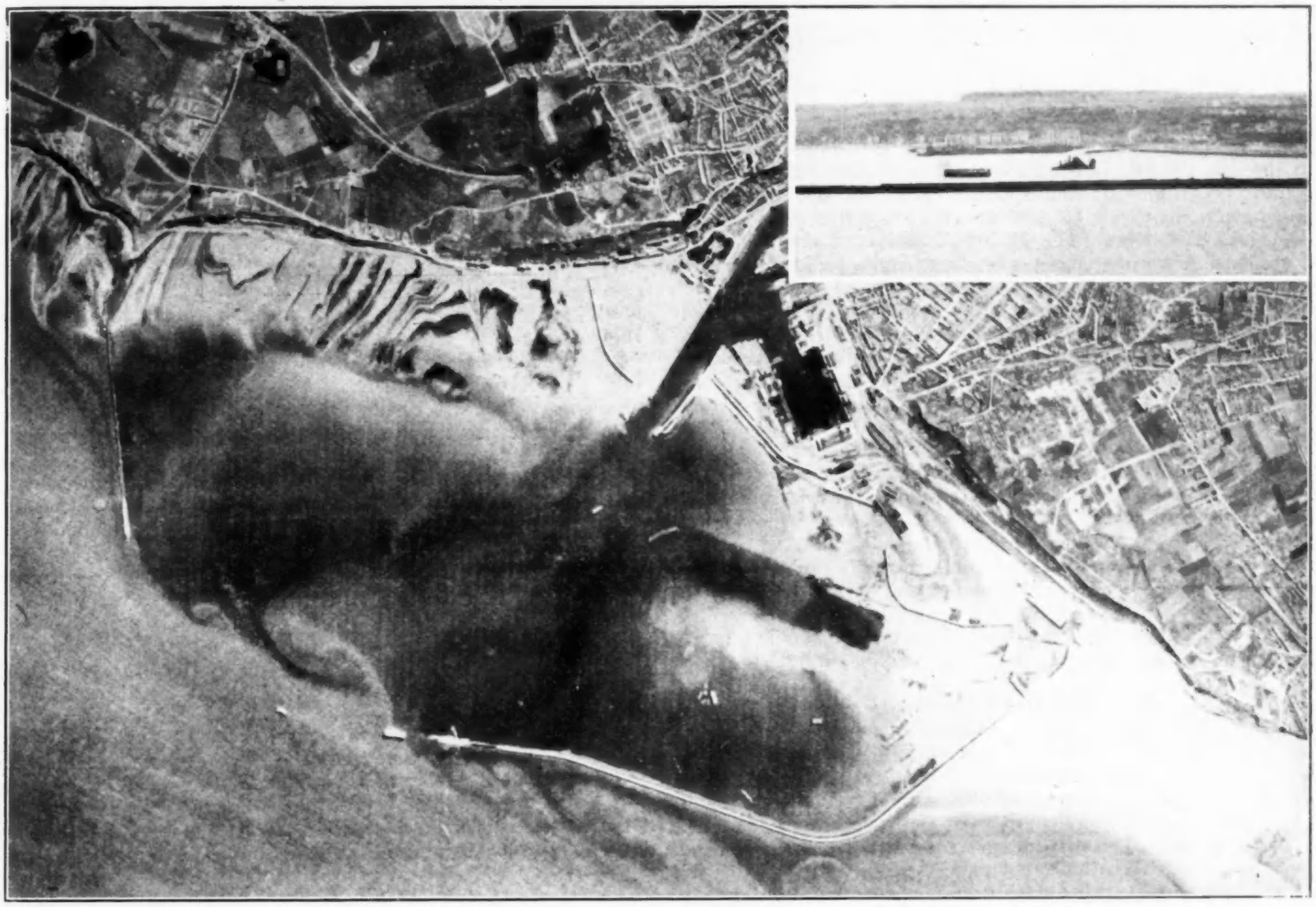
The Echo sounder and graphic recording apparatus is, of course, a great asset in hydrographic survey work and records much which would be missed by ordinary lead surveys, unless exceedingly close soundings or sweeps are made, and with its radial efficiency enables, for example, the elusive knife edge of an upturned wreck to be located.

Many vessels have found sunken wrecks and pinnacle rocks by the simple method of striking them. One could name many such rocks in the Seven Seas.

A classic of maritime surveying was the Tucker Rock in Torbay,

The above photograph of Boulogne Outer Harbour was taken at the time of maximum spring tides when the east-going tidal stream in the channel had been running for about half an hour. Part of the strongly flowing tidal stream flows into the harbour through the dredged channel and is deflected by the line of incomplete breakwater foundations. This configuration of the harbour, together with the complex channel tides, causes a whirlpool formation of the silt, which blocks the Outer Harbour, resulting in the necessity for constant dredging.

Hydrography from the Air—continued



Boulogne (above) seen at low tide. The dredged channels through the silt are apparent and the oblique photograph inset shows a dredger at work in the Outer Harbour.

which by its formation had eluded the lead line and was therefore not charted. The tide splits around the rock and would carry the plummet wide of the pinnacle and thus one of our naval vessels, when manœuvring to take up station with the visiting battle fleet, struck what is known to-day as the Tucker Rock and so named in respect to the fisherman who responded to the call of the naval surveyor sent to locate the danger.

This discovery of a rock uncharted at the doorstep of our hydrographic centre is an example of the unseens of hydrography which can be made visible to-day by the camera.

Polish Maritime Economy in 1948

According to information published by the Polish Ministry of Shipping, excellent results have been obtained, in the past year, in the restoration and extension of Poland's ports, shipyards and fishing establishments.

In many respects, 1948 was a crucial year for the development of the maritime economy of the country, and the growing production and needs of the rapidly expanding industry and commerce, called for the utmost effort on the part of all those responsible for the running of the ports and shipyards. Since the first ship arrived in the Port of Gdynia in July, 1945, a total of about 20,000 vessels have entered Polish ports, and the volume of goods handled has exceeded 35,000,000 tons. In respect of handling capacity, the combined ports of Gdynia-Gdansk hold the first place in the Baltic, and the third in continental Europe, being surpassed only by Antwerp and Rotterdam.

The Port of Szczecin,, formerly a secondary port designed for imported goods, is being developed to serve as an export centre for not only Poland, but also Czechozlovakia and the Danubian countries. An indication of the rapid expansion of this port is shown by the fact that 44,000 tons of goods were handled there in 1946 as compared with 3,150,000 tons last year, and according to estimates for 1949, this volume is expected to be still further increased. An equally satisfactory development of the much smaller ports of Ustka, Darlowo and Kolobrzeg, in Western Pomerania, is also reported.

As regards the Polish merchant fleet, the total tonnage is now 30 per cent. higher than before the war, and many regular lines are run by Polish shipping companies to the most important ports of Europe and overseas. Despite the progress made, however, the shipping fleet has not yet reached the desired standard, as many of the vessels are obsolete, and the size of the fleet is not sufficient to meet the economic needs of the country. Accordingly, an extensive ship-building programme has been put in hand in Poland, and orders have also been placed with foreign shipyards. Two cargo vessels the "Warmia" and "Mazury," built in British shipyards and delivered recently, are already in service.

The recovery of the Fishing Industry also has made considerable progress. The fishing fleet, practically non-existent at the end of the war, now consists of 33 deep-sea trawlers, 247 cutters and 1,148 various service boats, including motor boats. The Baltic and deep-sea fishing yielded 39,000 tons of fish in 1947, and it is estimated the total was over 50,000 tons last year. Fish refrigerating plants which are due to be put in service during the coming year at Gdynia, and other ports, will facilitate a more regular distribution of fish throughout the country.

Ports and the Transport Act, 1947

Examination of the New Legislation

By W. E. TAPPER, A.M.Inst.T.

The Transport Act with its 128 sections, expanding into more than 500 sub-sections, and its fifteen schedules opens a new era in the transport history of this country. It is the first attempt to legislate comprehensively for all forms of inland transport—except air—in one enactment. The British Transport Commission are now responsible for the efficiency of our public transport services by land and inland waterways.

Behind the Commission stands the Minister of Transport armed with powers to give directions to the Commission to make orders and regulations and to hold inquiries. His approval is needed to give effect to many of the decisions of the Commission. Treasury approval, as is customary, has also to be obtained in certain financial matters.

The legislation in the Act specifically relating to ports is confined to three sections (of which two are devoted to licensing of facilities), and a share in half-a-schedule, and becomes operative at the discretion and on the initiative of the Commission, or by direction of the Minister. Lest it be thought that this is a meagre portion of the legislative bounty it should be added that ports are mentioned elsewhere in the Act and other parts of it can be made applicable to them.

The marginal references are the sections, etc., of the Transport Act and other Acts.

Commission's Duties and Powers

S3 (1) The general duty of the Commission is to provide or promote or secure an efficient, adequate, economical and properly integrated system of public inland transport and port facilities, and to take the steps they consider necessary for extending and improving them so as to provide efficiently and conveniently for the needs of the public, agriculture, commerce and industry. They are
S4 (1) to comply with any directions which the Minister may give them on matters of policy.

S2 (1) (h) The extensive powers conferred on the Commission authorise them, inter alia, to provide port facilities
S2 (2) (f) within Great Britain. Besides the undertakings which are compulsorily vested in the Commission by the Act they may acquire by agreement other undertakings
S4 (4) whose activities are similar to their own. The Minister's consent is needed for the acquisition in this manner of any harbour and other specified classes of undertakings. The Commission have already acquired by agreement some important road transport undertakings, both passenger and goods, and the business of at least one inland waterway carrier.

S7 (1) The owners may transfer their undertakings by agreement to the Commission notwithstanding any statutory provision or instrument to the contrary, and the Minister
S7 (2) may make regulations putting the undertakings on a similar footing to those compulsorily vested in the Commission.

S2 (2) (i) The Commission may lend money or give guarantees to a person or a body corporate carrying on or about to carry on activities similar to their own.

S12 Part II of the Act vested in the Commission on the 1st January, 1948, the whole of the railway and canal undertakings, including their harbours and docks, mentioned in the third schedule. The Commission have thereby become the largest dock owners in the world. Their advertisements boast of the control of 76 separate harbours and docks. The total length of quays acquired by the Commission exceeds 500,000-ft. or nearly 100 miles, ranging from 64,000-ft. at Hull to a few hundred feet at small shipping places.

S14 (2) The Commission take over the rights, liabilities and obligations of their predecessors, and for the time being carry on the undertakings under the same statutory powers as were in operation immediately before the transfer.

Ports belonging to local trusts or commissions, municipalities and companies—conveniently termed 'independent ports'—are not swept holus bolus into the nationalization net as railway and canal undertakings are and as the long distance road transport of goods is soon to be.

Any changes which may be decided upon for the independent ports will be carried out under another part of the Act.

The Executive

S5 (3) The Docks and Inland Waterways Executive, one of the five Executives created at the outset, consists of a chairman, three other whole-time members and three part-time members.

S5 (4) The Executives, as agents for the Commission, exercise the functions delegated to them by schemes made by the Commission and approved by the Minister. They take over the rights, powers and liabilities of the Commission in respect of the delegated
S5 (9) (b) functions and are treated as the employers of officers and servants.

The scheme of delegation approved by the Minister for the Docks and Inland Waterways Executive transfers to them the management of inland waterways of the undertakers mentioned in Part II of the third schedule, i.e., the formerly non-railway owned waterways. Several of these concerns were also dock owners.

The management of the docks and canals formerly owned by the railway companies was temporarily placed in the hands of the Railway Executive on 1st January, 1948, with the intention of transferring the management later to the Docks and Inland Waterways Executive. The docks in South Wales formerly owned by the Great Western Railway were so transferred on 1st August, 1948. Several of the canals were likewise transferred about the same time. The transfer of the Humber ports of Hull, Grimsby and Immingham, formerly owned by the London & North Eastern Railway, took effect on 1st January, 1949. Other transfers will be made in due time, although it is probable that the management of the ports mainly used by the Railway Executive's steamship services will be left with that Executive.

The Executive may employ agents to perform any of their functions.

The delegation allows the Executive to acquire or dispose of property required or used for the purpose of their functions, but the purchase or sale of land is reserved to the Commission. The Executive may, however, on behalf of and in the name of the Commission, acquire or dispose of land on lease or any other form of tenancy.

The Executive are to have the use and enjoyment of any property held or used for the functions delegated to them, and may authorise its use by another Executive or other persons.

The delegation excludes promoting or opposing bills in Parliament, the creation or issue of British transport stock, the submission of schemes, reports, accounts or other documents to the Minister, the licensing of canal carriers or any of the functions in regard to charges schemes, all of which are left in the hands of the Commission.

The Executive are not authorised to acquire other undertakings by agreement, or, unless so authorised by the Commission, to dispose of any part of the undertakings placed under their management. They may not enter into agreements as to the amount of com-

Ports and the Transport Act, 1947—continued

pensation payable in respect of the transfer of an undertaking under the Act.

In any legal proceedings pending on 1st January, 1948, the Executive take the place of the former proprietors.

The Commission with the consent of the Minister may at any time revoke or vary the delegation of any functions to the Executive. The scheme as drawn allows for the extension of its scope.

The effect of delegation is that users will deal with the Executives, and not with the Commission.

Harbour Schemes

S66 The provisions particularly relating to ports are contained in Part IV of the Act. Here ports are placed cheek to jowl with passenger road transport. These two unexpected bedfellows are to have the same principles and procedure applied to them for determining any reorganisation which may be decided upon. S63, 64 and 66 Their legislative affinity is proclaimed and established by the use of common wording, mutatis mutandis, in some parts of their respective sections.

Ports receive the new designation of trade harbours. S66 (1) The designation includes all harbours in Great Britain, except those normally used only by pleasure steamers, yachts, fishing vessels and vessels not registered under the Merchant Shipping Acts. Government dockyard ports are also excluded.

There are three definitions which should be kept in mind when considering this part of the Act, viz:

S125 (1) 'Harbour' means any harbour, whether natural or artificial, and any port, haven, estuary, tidal or other river or inland waterway navigated by seagoing ships, and any dock.

S66 (10) 'Harbour undertaking' means an undertaking or part of an undertaking the activities whereof consist wholly or mainly of the construction, improvement, maintenance, management, regular marking or lighting of a harbour or part of a harbour.

S125 (1) 'Port facilities' of all kinds are grouped together, but it is convenient to divide them into two categories:

1. Those provided by the port, conservancy or local lighthouse authority and having a similar definition to 'harbour undertaking,' viz.:

> The constructing, improving, maintaining, regulating, managing, marking or lighting of a harbour or any part thereof.

2. Those which may be termed the ancillary facilities and which are provided partly by the port authority or wholly or partly by private enterprise, viz.:

> The berthing, towing, moving or dry-docking of a ship which is in, or is about to enter, or has recently left a harbour, the loading or unloading of goods, or embarking or disembarking of passengers in or from any such ship, the lighterage or the sorting, weighing, warehousing or handling of goods in a harbour.

Pilotage is not mentioned nor are dock railways.

S66 (2) The Commission are to keep trade harbours under review (a duty which they have delegated to the Docks and Inland Waterways Executive) in order to decide whether the powers conferred on them shall be exercised. (The Commission are reserving this decision to themselves).

S66 (3) The Commission may with the object of securing the efficient and economical development, maintenance or management of a trade harbour or group of harbours prepare a scheme for submission to the Minister. They are to take into consultation the proprietors of the harbour undertakings concerned and bodies representing shipowners, traders and workers actually connected with the harbour or group of harbours. These parties have no right to ask for a scheme, the initiative resting solely with the Commission.

Contents of a Scheme

A scheme may provide for all or any of the following matters set out in eleven paragraphs labelled (a) to (k):

paras. (a) (b) & (d) Constituting or specifying the body or bodies who are to provide the port facilities, and the body or bodies who are to administer or take part in administering the scheme, for transferring any harbour undertaking in the harbour or harbours to any such body, and for specifying the port facilities which are to be provided by them.

S66 (6) It is laid down that no monopoly of the facilities as defined in the second category is to be conferred on any of these bodies. There is, however, to be no interference with any exclusive right exercisable immediately before the operation of the scheme whether statutory or by right of property. In other words, status quo is maintained and any rights of the port authority in this respect will be transferred to the 'facilities' body, whilst for example a tenant on the dock with waterside premises will continue to enjoy any rights allowed to him under his lease to provide his own facilities.

It is contemplated that there may be a separate body or bodies for providing what may be termed statutory facilities as enumerated in the first category and one or more different bodies for administering or sharing in administering the scheme. This is contrary to precedent as hitherto the providers of the main statutory facilities have been invariably regarded as the administrators of the port.

The duties of a 'facilities' body will be severely practical, whilst those of the administrative body will be in the nature of supervision, and where more than one harbour is concerned of co-ordinating the activities of the group.

S66 (4) The Commission may be the body or one of the bodies specified in a scheme. A part of their undertaking may be transferred, for example, to round off a grouping scheme, or where they own a dock or wharf in a port managed by another body.

S66 (5) The Commission are to consider the desirability of including amongst the members of an administrative body (except when the Commission is the body) persons who are payers of dues or who are otherwise interested in the trade and activities of the harbour or harbours and also of administering the scheme in the vicinity.

The intention seems to be to give the Commission considerable latitude in framing their schemes so that they can adapt them to the needs and peculiarities of each particular case.

S66 (3) The functions may be entrusted to new bodies set up for the purpose, or to existing bodies. Their pluralities tend to be a trifle confusing. It is possible that there may be four or more bodies concerned with a single scheme. One is left wondering why so many are thought to be necessary. By contrast the Commission, amongst their multifarious responsibilities, have the duty of administering and managing, with the help of an executive, their own harbour undertakings consisting of some fifty ports and many small docks and wharves. All of these are inter-mingled around the coast with the independent ports, which, if brought under a scheme, either individually or in groups, may be controlled by several bodies.

para. (c) A scheme may regulate the relations of persons carrying on harbour undertakings in a harbour or group of harbours and in particular may provide for the pooling of receipts and expenses.

Ports and the Transport Act, 1947—*continued*

para. (e) The construction, improvement or extension of a dock may be prohibited or restricted otherwise than under the scheme. The object is no doubt to avoid redundancy of costly facilities. If this stipulation is inserted and a new dock or an extension became necessary at some future time a new scheme would be required. Parliamentary powers, as at present, would, it is assumed, have also to be obtained.

para. (f) A licensing system may be imposed on persons providing facilities other than those entrusted to a body specified in the scheme. Sections **66** and **67** set out the procedure, and are referred to later.

Application of Other Provisions of the Act

paras. (g) (h) & (i) Then follow three paragraphs incorporating, with or without modifications, other provisions of the Act in relation to the bodies mentioned in the scheme.

para. (g) S88 (2) The first relates to borrowing or issue of stock including guarantees by the Treasury. Part VI of the Act (Finance) authorises the Commission to borrow paras. (a) (c) & (d) money by the issue of British transport stock for various purposes, including new capital works, working capital and for payment of compensation which has to be defrayed in cash. They may also raise money in this para. (f) way to make loans to corporate bodies and persons carrying on or about to carry on transport activities.

S89 (1) (b) They are to create and issue stock for any compensation which has to be satisfied by the issue of British transport stock.

S88 (2) S89 (1) paras. after provisos The borrowing powers for compensation purposes can be applied to a scheme or order made under the Act, but there is no mention of applying to schemes the other borrowing or lending powers or otherwise giving guarantees.

The borrowing powers of the Commission for new works and working capital seem to be limited to their own requirements, and not intended to apply to a body mentioned in a scheme.

The powers of the Commission to lend money to a body corporate or person may however be construed as being wide enough to allow them to lend money to a body charged with the duty of providing port facilities under a scheme. A loan would not be made to a body administering the scheme. This seems to be confirmed S66 (3) para. (h) by the fact that no power is to be conferred on administering bodies to levy charges.

The position is that only the Commission can issue transport stock and it seems that a 'facilities' body must look for their capital requirements to the Commission to whom the body will presumably refund interest, etc.

These comments refer to a body other than the Commission. Where the Commission are the body all the provisions of the Act relating to their powers become applicable.

para. (h) The next paragraph refers to the charging powers of a body providing port facilities. A scheme may either (i) include any of the provisions of Part V or any scheme or regulation made thereunder or (ii) apply any other statutory provisions as to charges to be made by the Commission whether for port facilities or not. Part V itself makes no mention of extending its provisions to harbour schemes operated by other bodies.

para. (i) The other paragraph in this connection enables any provisions of the Act relating to transfers to the Commission to be applied to the transfer of a harbour undertaking under a scheme including the compensation provisions.

para. (j) A scheme may repeal or amend a previous scheme.

para. (k) Finally, there is the authority for making consequential or incidental provision as may be necessary or expedient for any of the purposes mentioned in the preceding paragraphs, including the repeal or amendment of any local acts or orders. This will not allow the introduction of extraneous matters not correlated to those paragraphs.

The right of a body other than the Commission to promote or oppose bills in Parliament is not mentioned nor is the relationship between the body and the Commission or between a 'facilities' body and an 'administering' body.

Many matters are open to doubt, and the practical application of the various provisions may turn out differently from what was contemplated when this section was being framed. A scheme may contain something less than all the provisions of paragraphs (a) to (k), but to go beyond would be ultra vires.

It will be for legal minds—and probably legal ingenuity—to put the schemes into workable shape.

A scheme will no doubt be expected to be self-supporting as far as is practicable, but the references to guarantees seem to imply that there may be circumstances where outside financial help may be needed. Where the Commission is the body providing the facilities under a scheme the harbour or group will form part of their whole undertaking and will not be treated as a separate financial entity as it would be under the ægis of another body.

S66 (9) The Minister may direct the Commission to prepare a scheme for a harbour or group of harbours. It is not laid down that the Commission are then obliged to consult with local interests as they must do when preparing schemes initiated by themselves.

S66 (7) A scheme cannot include a private dock, oil or coal dock or dry dock without the consent of the owner, or unless it is carried on under statutory powers.

S66 (10) A private dock is defined as one used exclusively by the owner for loading or unloading his own goods and materials. Oil and coal docks are those used exclusively for loading or unloading oil in bulk and coal respectively. Dry dock has the definition usually associated with such an undertaking, viz., for cleaning or repairing ships.

Further Procedure

S66 (8) A scheme does not become effective until embodied in an order made by the Minister, and before he does so the Eighth Schedule comes into play.

Sch. VIII para. 1 The Minister must satisfy himself when the transfer of an undertaking is to take place that proper provision is made for compensation.

para. 1 (a) S25 (4) & (5) Where local authorities are concerned the terms of compensation are to be on the lines laid down for them in Part II. Briefly these are that a local authority is to be refunded the interest payable on outstanding securities and payments into redemption funds in respect of the transferred undertaking. In addition a sum not S114 exceeding **£200,000** is earmarked for apportionment amongst local authorities in respect of severance should their docks be transferred to the Commission or other bodies.

A local authority will thus be relieved of all financial liability, including, of course, any burden which may fall on their ratepayers in regard to the transferred undertaking, whilst their stockholders, unlike those of railway companies, will continue to receive the same income as before from their investments. This is perhaps as generous compensation as any under the not very generous compensation terms of the Act. There will be change in administration and management but the docks remain to be managed and developed for the benefit of the local community.

Sch. VIII para. 1 (b) Where the transfer is comparable with a transfer under Part II or III the compensation is to be satisfied in accordance with those parts of the Act, i.e., either by

Ports and the Transport Act, 1947—continued

British transport stock in exchange for securities or by cash payment for the value of physical assets with an allowance for loss of profits.

para. 1 (c) In any other cases the compensation must be such as the Minister thinks proper.

S102 (1) A scheme must also provide for compensation to employees who suffer in any way in consequence of the transfer of an undertaking. This also applies to undertakings transferred to the Commission by agreement.

Sch. VIII para. 1 (2) If the Minister is not satisfied with a scheme he may refer it back to the Commission with his observations. They are then to re-consider the scheme and submit it again to the Minister with any amendments they think fit.

para. 2 (1) When the Minister has prepared his draft order he has to give suitable notice locally and in the Gazettes stating where the order can be inspected and copies obtained, and the time (not less than 40 days) and the manner

para. 2 (2) for lodging objections. Objectors may ask for amendments, additions or modifications of the scheme, but not for its withdrawal.

para. 3 (1) If there are no objections, or if all of them are withdrawn, the Minister may make the order with any minor alterations he thinks necessary.

para. 3 (2) If objections are persisted in there is to be a public inquiry and after considering the report of the inquiry the Minister may make the order as drafted or with any alterations he thinks fit.

S66 (8) Should there still be objections which are not withdrawn when the order is made, it will become subject to special parliamentary procedure which gives objectors the right to petition. The procedure is laid down in the Statutory Orders (Special Procedure) Act, 1945.

Licensing of Facilities

Where a scheme provides for the licensing of port facilities, Sections 67 and 68 come into operation. The licensing authority shall be the body so declared in the scheme.

S67 (2) Licensing will apply to all facilities except those which are to be provided by the body or bodies named in the scheme or as may be otherwise laid down in the scheme. The facilities subject to licensing will generally be those set out in the second category mentioned earlier (under the sub-heading "Harbour Schemes").

S67 (3) A licence may be granted for such period and with such conditions (including conditions as to charges) as the licensing authority think fit and may be revoked at any time.

There is, however, a proviso that unless the licensing authority consider it expedient in order to secure the better use of the harbour in the national interest or its economical improvement, maintenance or management, they shall not refuse or revoke a licence or impose conditions, or without the consent of the applicant grant it for less than seven years. The proviso seems to supersede and stultify largely its antecedent paragraph.

There is no restriction placed on newcomers as applicants for licences, nor are any tests laid down as to qualifications or competence.

S67 (5) The penalty for contravention is a fine not exceeding £10 on summary conviction. If the contravention is continued afterwards, the fine is one not exceeding £10 for each day it continues.

S67 (4) An aggrieved licensee or applicant for a licence may appeal to the Transport Tribunal, and the licensing authority are to give effect to any order made by them.

S68 (1) If an aggrieved appellant, who was in this line of business on 28th November, 1946, has his appeal refused wholly or in part and the Tribunal are satisfied that their refusal will substantially interfere with the business he continued to carry on up to the time of determination by the licensing authority, they may on his application declare that his business or some part of it shall be transferred to the licensing authority or some other body administering the scheme or providing facilities thereunder.

S68 (2) If the appellant and transferee fail to come to agreement as to terms within six months the appellant may apply to the Minister for an order giving effect to the transfer. The Minister may allow the application to be made earlier if he sees no prospect of the parties agreeing.

S68 (3) The order shall provide for the transfer, including the payment of compensation, to be made on similar lines to compulsory transfers under Part III of the Act (Road Haulage), unless the Minister considers that Part III is not comparable, in which case he may apply the relevant provisions of Part II for compensation, or may otherwise allow compensation as he thinks proper.

Both parties are to be given the opportunity of being heard by a person appointed by the Minister before an order is made.

S68 (4) The parties may agree between themselves to vary the extent of the transferred undertaking as compared with the Tribunal's declaration.

S102 (3) Suitable compensation has also be given to employees who suffer loss.

Coastal Shipping

S70 Another attempt is made to improve the relationship between coastal shipping and railways and road transport. The Commission are empowered to enter into agreements with coastal shipowners for co-ordinating activities; in particular for through carriage facilities and through rates and the pooling of receipts and expenses.

S71 The Coastal Shipping Advisory Committee provided for in the Act has recently been appointed, and consists of eight members representing the interests of persons engaged in coastal shipping and eight representatives of the Commission.

If the Committee make a report to the Minister on any matter, he may give directions to the Commission to exercise their powers in regard to that matter with the object of ensuring that efficient coastal services are maintained in the national interest.

The evidence given before the Charges Consultative Committee in 1946 showed the difficulties and handicaps of coastal shipping. All concerned with ports will hope that after the failure of the measures in the Railways Act 1921 (s. 39) and the Road and Rail Traffic Act 1933 (s. 39) to afford protection to coastal shipping from undue competition the latest attempt will be more effectual.

(To be continued)

Basingstoke Canal Appeal.

At an open meeting of the Basingstoke Canal Committee formed by the Inland Waterways Association on February 13th, the desirability of maintaining the canal in being was agreed, and it was unanimously decided to form a Basingstoke Canal Trust to appeal for funds in the hope of acquiring the canal. Between £2,000 and £3,000 has already been promised. It is pointed out that the canal could be made navigable from Byfleet, where it joins the Wey, to Basingstoke, and it was intended to keep the towing path for ramblers and provide facilities for swimming, skating, fishing and for the mooring of craft.

Notes of the Month

Improvement Scheme for the Port of Duala, Cameroons.

It is proposed to call for tenders for equipment and material for additional berthing and quay facilities for Duala, and then to commission a company to dredge and widen the Wouri channel to permit vessels with a draught of 23-ft. to make use of the port at all times, except possibly at neap tides. It is hoped that work will begin towards the end of this year, in which case the whole undertaking may be finished by the end of 1950.

Facilities for Grangemouth Dockers.

A canteen and medical centre for Grangemouth dockers is to be erected in the dock area at an estimated cost of £35,000. An official of British Railways, owners of the docks, said recently that better facilities have been discussed for some time past, the site has been fixed and the necessary permits applied for. The recent Working Party on the turn-round of shipping reported the need for a canteen and more shelters.

The Port of Haifa, Palestine.

Since the proclamation of Israel, 650 ships totalling 900,000 tons, have called at Haifa port. Nearly a quarter of a million tons of imports have passed through the harbour, as well as 18,000 tons of exports. The present daily average is 2,500 tons as against 500 at the beginning of the period. Since the establishment of the State, there has been a marked reduction in theft, breakage, and mishandling, sufficient to enable the lowering of insurance rates.

Holland's Inland Water Fleet.

By the end of 1949 the Dutch inland water fleet is expected to number 17,100 vessels, totalling 5,000,000 tons, as against 20,000 ships totalling the same tonnage prior to the war, and 9,000 vessels of 1,800,000 tons at the date of Holland's liberation. These figures indicate the restoration of the inland water fleet to its pre-war level by the close of the year. Owing to the unfavourable relation between building costs and business results, new ships are now ordered only in exceptional cases.

Economy in the Use of Steel.

A widespread campaign for economy in the use of steel has been inaugurated by the Minister of Works, Mr. C. W. Key, in conjunction with the Minister of Supply, Mr. G. R. Strauss, at the request of the Government. An official committee, called the Steel Economy Committee, has, after two years' work, issued an interim report. In reviewing the possible fields of economies in different industries, it states that welding is of great importance as a method of economising in ship-building. The report indicates a weight economy of 11.68 per cent. in a welded ship of about 9,000 tons d.w. as compared with a like ship of riveted construction and a 9.25 per cent. economy in regard to a Thames dumb barge.

Improvements at the Port of Glasgow.

Shieldhall riverside quay, which fronts a timber yard of approximately 12 acres with four timber storage sheds and which would also serve mineral traffic, is to be reconstructed, according to a minute of the General Purposes Committee which was recently approved by the Clyde Navigation Trust. The work involves the construction of a new 900-ft. quay wall to give 32-ft. at L.W.O.S.T. and the necessary dredging, increasing the river width by about 80-ft., paving of the quay in setts and surfacing the timber yard in concrete, and the provision of new crane rails of 16-ft. gauge, five new 5-ton level luffing cranes with electrical equipment, electrical capstans, and new railway tracks and connections to existing tracks with open space lighting. It is estimated that the time taken to complete the work will be from three to 3½ years from the letting of the contract. The work is estimated to cost £776,000, which will also cover rail laying and other alterations estimated to cost £26,500 at the west quay of King George Dock to continue timber discharge facilities there pending the reconstruction.

Renewal of Dock Sheds at the Port of London.

The Port of London Authority has authorised works of repair and reinstatement of war damage to be carried out on the dock sheds at Wapping shed and quay, Wapping Basin, Rotterdam shed, South Quay; No. 14 shed, Brunswick Yard, Surrey Commercial Docks; and No. 2 shed and berth, South Quay, King George V Dock. Also, to augment their existing plant for the discharge of grain, the Authority has placed an order for the building of two diesel-driven floating grain elevators at a cost of £281,000.

Shoreham Harbour Improvement Scheme.

Work will start shortly on a £1,500,000 development scheme at Shoreham Harbour to enable larger colliers to enter with coal supplies for the new power station which is now under construction. The scheme will be carried out by the Harbour Trustees in collaboration with the British Electricity Authority, and will include the widening of the harbour entrance, the demolition of the pier on the eastern side of the entrance, and a new lock, 360-ft. by 55-ft., to replace the present one. It is estimated that the scheme will take three years to complete, and that colliers of up to 4,500 tons will then be able to enter the harbour.

Proposed Developments at Chittagong.

It is reported that the Port of Chittagong is to undergo a rapid expansion so that trade can pass freely between East and West Pakistan. The port is to have 12 berths to receive ocean-going vessels and not four as at present, and plans are also being made to provide 18 berths. As the land route is closed to West and East Pakistan for the exchange of goods, there is no alternative but to take goods by sea, and it is imperative that port facilities at Chittagong should be adequate. In addition, arrangements are to be made to enable vessels to be loaded or unloaded in mid-stream.

Dredging at The Hartlepools.

The annual report, submitted to members of The Hartlepool Port and Harbour Commissioners early last month, shows that dredging operations in the Hartlepool channel from April to December last resulted in 350,000 tons of silt being raised and sent to sea at a cost of £16,000. The minimum depth on the centre line of the channel has been maintained at between 16 and 17-ft. Repairs and renewals in the dredging department have been heavy. The pier has now been cleared of all defence works and the cost recovered from the appropriate Government departments. A new buoy of improved pattern has been purchased and put in place at the outer end of the channel, and after tests it will be equipped with the latest type of electric flashing light. Harbour dues received during the year amounted to £8,300, and import and export tolls £10,200. Shipments of coal during 1948 totalled 1,986,830 tons, an increase of 268,880 tons on the previous year.

Improvement Scheme for Newry Harbour.

A scheme estimated to cost £122,250 for dredging Victoria Lock and approaches at Newry, Co. Down, providing a jetty, wharves, training walls, and sluicing, constructing a new wharf at Albert Basin, dredging the new berth, and erecting a 200-ft. long goods shed and new lairages, was considered by the Newry Port and Harbour Trust early last month. The report of the Consulting Engineers, Messrs. Ferguson & McIlveen, of Belfast, pointed out that the increase in width of the channel would entail a considerable increase in the amount of mud to be dredged and a corresponding increase in the reclamation area which would cover about 7½ acres. The surface of the reclamation area would finish about 4-ft. above high water level. A wharf constructed of steel sheet piling and extending for 1,200-ft. would enclose the reclamation area on the east side; a rubble bank would enclose it on the south side. It was decided to hold a joint meeting of the trust and Newry Urban Council to prepare a case for presentation to the Ministry for a grant to carry out the scheme.

New British Standard Specifications

A number of revisions have been made recently to British Standard Specifications, and some of the more important are noted below:—

The Use of Structural Steel in Building, B.S. 449. One of the important features of this revision is that the stresses have been increased. These have now been related to the yield stress of the steel and to achieve this B.S.15 has also been revised to include requirements for the yield stress. The other steel specifications to which the document relates are B.S.534 and B.S.968 for high tensile steels. It is not applicable to steel structures fabricated from steel tubes or light gauge sheet and strip steel. Requirements specified for " loading " relate to dead loads, superimposed loads and wind pressures, and have been reproduced with minor modifications from B.S. Code of Practice C.P. 4 : 1944, Chapter V, Loading, of the Code of functional requirements of buildings. Dynamic loads are also covered.

The permissable working stresses are specified in relation to tension, bending, shearing, bearing, and for rivets, bolts and welding. The standard has been amplified to provide for welded construction. The stresses in welds are limited to those of mild steel to B.S.15. Specific requirements and recommendations are given for fabrication and erection and for work both on site and off site. The specification is based on the simple method of design, but includes reference to the semi rigid and fully rigid methods.

Copies of this standard may be obtained from the British Standards Institution, Sales Department, 24, Victoria Street, S.W.1, price 6s. post free.

The Institution has also published a revision of the **British Standard for Structural Steel for bridges, etc., and general building construction (B.S. 15 : 1948).**

In response to representations which have been made by structural engineers, it has been decided to include a requirement for a minimum yield stress for steel manufactured to this standard. In view of the importance of this addition, it has been considered desirable to give effect to it by the issue of a revision of the standard rather than by an addendum. The opportunity has also been taken to co-ordinate the tolerances for dimensions and weights with the corresponding tolerances adopted in later standards for structural steel. The forms of test piece have also been modified to conform to those included in B.S.18.

The standard specifies process of manufacture, test methods and requirements, permissible margins on weights and dimensions, marking, provision of test certificates and inspection procedures. Tests on manufactured rivets are also described.

Copies of this standard can be obtained from the same address as above, at a cost of 2s. post free.

British Standard for Electrically Welded Mild Steel Chain (short link and pitched or calibration) for lifting purposes. (B.S. No. 590 : 1949).

During recent years there has been considerable development in the manufacture of electrically welded chain which is now in extensive use.

In consequence, B.S.590 (first published in 1935) has been revised and amended in the present issue. The 1935 edition included two qualities, "standard" and " special," differing in test load but rated at the same working load. The present 1949 edition deals only with one quality equivalent to the previous "standard ". A further British Standard is in course of preparation for electrically welded chain of higher tensile.

The maximum size, previously 17/32 inch, has now been increased to 1½ inches and the wire gauge sizes for chain under 5/16 inch are more nearly exact. In place of a minimum extension under a pre-determined test load without fracture, a minimum energy absorption factor (the product of breaking load in tons and elongation in inches) has been substituted.

In the foreword, with a view to ultimate standardization of pitched chain, it is recommended that, wherever possible, purchasers should adopt one standard outside length of link of five times the nominal diameter of the steel from which the links are made. The foreword also recommends users to take all possible steps to ensure the ready identification of mild steel chain and to keep it separate from wrought iron chain, as periodical heat treatment (necessary in the case of wrought iron chain) should be avoided for mild steel chain.

There are three appendices of general interest:—

Appendix C.—Safety recommendations for the use, care and maintenance of chain and chain slings. These recommendations of display size, together with table of proportionate loads for two-leg chain slings dependent on included angle, will later be available as a separate publication.

Appendix D.—Distinguishing wrought iron fire welded chain from electrically welded chain.

Appendix E.—Energy absorption factor giving an explanation of this term.

Copies of this standard may be obtained from the same address as above, price 2s. 6d. post free.

The Port of Calcutta

Increased Traffic during Past Year

Recently published details of trade at the Port of Calcutta for the year 1947-48 show that in spite of the partitioning of Bengal, there was an overall increase, compared with the previous year, of about 21.7% in imports and 1.5% in exports. Imports totalled 2,483,744 tons as compared with 2,039,451 tons last year, the principal increases being recorded for cement, machinery, oils, petroleum and salt. On the other hand, food, grain and seed imports decreased by 138,282 tons. Exports were 4,465,784 tons, against 4,398,614 tons for the previous year, the principal increases being coal (including bunkers), gunnies, jute, seeds and tea. Of the total seaborne traffic of 6,949,528 tons, 4,349,148 tons, or about 62%, passed over the Commissioners' quays.

In regard to the scheme to carry out model experiments with a view to effecting permanent improvements to the River Hooghly, the Commissioners sanctioned estimated capital expenditure of Rs. 9,00,000 for the construction of models and an expenditure of Rs. 81,000 per annum for carrying out the experiments. With a view to improving the system of communication on the river, it has been decided to substitute the existing arrangements by the introduction of wireless telegraphy and telephony. It was decided in the first instance to establish receiving and transmitting stations at Calcutta, Hooghly Point and Saugor and on board five of the Commissioners' vessels, and later to instal a wireless beacon at Saugor. Some of the equipment needed for these improvements has already arrived.

Capital expenditure during the year amounted to Rs. 71,84,291, and included the purchase of two tugs (Rs. 1,17,500), payment on account of the suction dredger " Jalengi," which is under construction (Rs. 13,29,786), construction of four 300-ton silt barges (Rs. 3,39,119), additions to dredging equipment (Rs. 3,11,433), purchase of the seagoing tug "Oberon" (Rs. 2,00,347), construction of river models (Rs. 3,09,036), purchase of five cranes (Rs. 7,00,717), extension of workshops (Rs. 11,28,123), and construction of eight new grain sheds at Jhinjirapul (Rs. 4,81,705). Income for the year amounted to Rs. 6,54,84,143 and expenditure to Rs. 6,11,60,284, and the surplus has been transferred to the revenue reserve and to the fire insurance fund.

BUSINESS ANNOUNCEMENT.

Head, Wrightson & Co., Ltd., engineers of Thornaby-on-Tees, announce that they have acquired the businesses of:— F. J. & L. Dean, Slough, Bucks (Consultants in aluminium fabrication). Aldean Designs, Ltd., Slough, Bucks (Designers of aluminium structures). D. J. Hawkins & Sons, Ltd., Stoke Row, Henley-on-Thames, Oxon (Fabricators in aluminium).

These businesses are being amalgamated with their subsidiary Head Wrightson Light Alloy Structures, Limited, and will in future be known as Head Wrightson Aldean, Limited, with headquarters at 61, Windsor Road, Slough, Bucks.

The Company also announce that in addition to their present contracts, they have booked substantial orders for aluminium structures for the Channel Islands.

SITUATIONS VACANT.

ENGINEERING DRAUGHTSMAN required for progressive position. Experience in mechanical handling equipment or with the installation desirable. Also vacancy for competent detailing draughtsman. Apply to Personnel Manager, Samuel Williams & Sons, Ltd., Dagenham Dock, Essex.

CAPABLE MAN to take charge of vessel mounting 15-ton Lobnitz Rockbreaker in Southampton Harbour. Only those with previous experience in the use of this type of equipment need apply to: Reed & Mallik, Ltd., 42 Berth, Old Docks, Southampton. Tel.: So'ton 2431.

LONDON REPRESENTATIVE required by well-known company of ship and dredger builders. Applications will be considered on a part-time or full-time basis, but applicants must be thoroughly experienced and well connected in the duties to be undertaken. Only first-class applications will be considered. Reply with full particulars to: Box No. 104, "The Dock & Harbour Authority," 19, Harcourt Street, London, W.1.

PORT OF MANCHESTER.—The Manchester Ship Canal Company invites applications for permanent positions, from Civil Engineering Draughtsmen with experience in the design of dock and harbour works and a knowledge of reinforced concrete and steel construction. Applications, stating age, qualifications, experience and salary desired, should be addressed to the Chief Engineer, Manchester Ship Canal Company, Ship Canal House, King Street, Manchester 2.

GRANTON HARBOUR, LTD., EDINBURGH.—Applications are invited for post of General Manager. Salary £1,000-£1,500 p.a., according to qualifications and experience. Candidates should be between age 40 and 50 and have practical knowledge and experience in responsible capacity of port and dock administration and operation. Engineering qualification an advantage. Applications, accompanied by full particulars, to Secretary, Granton Harbour, Ltd., Granton, Edinburgh 5, not later than 26th March, 1949.